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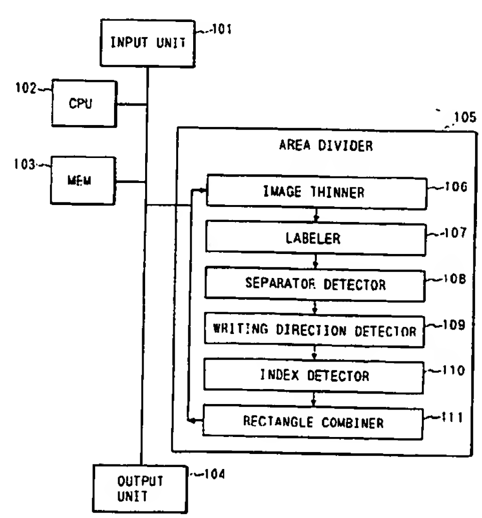
(54) **Image processing method and apparatus.**

(57) An image processing apparatus comprises : an image input unit to input an image ; an image thinner for getting the OR of (m dots in the vertical direction) x (n dots in the horizontal direction) for the input image from the image input unit, thereby thinning out the (m x n) pixels and newly forming one pixel ; a labeler for adding labels every line to black pixels of the image which was thinned out by the image thinner and adding the same label to the pixels which are continuous in the vertical, horizontal, or oblique direction and simultaneously tracing a rectangle ; and a separator detector for distinguishing a rectangle corresponding to a sentence portion, a rectangle corresponding to a figure or photograph, a rectangle corresponding to a table, a rectangle corresponding to a separator, and the like by using a width, a height, an area, and a pixel density (the number of pixels to the area) of the rectangle added with the label by the labeler. On the basis of the result of the detection of the separator detector, the area of the input image is divided.

FIG. 1



EP 0 587 450 A1

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to an image processing apparatus for, particularly, dividing an input image into a character area and an area of a figure, table, or the like in an electronic apparatus such as OCR (optical character recognizing) apparatus, copying apparatus, facsimile apparatus, or the like.

Related Background Art

In a conventional image processing apparatus, there is an apparatus using a run length analyzing method as area dividing means whereby a distribution of run lengths is examined and a character area, a figure area, or the like is divided in accordance with a length of white run or black run, an apparatus using a spectrum analyzing method whereby a Fourier spectrum of an input image is analyzed and the input image is divided into various kinds of areas, an apparatus using a projection analyzing method whereby projections (histograms) in the vertical and horizontal directions are alternately repeatedly obtained and the area is divided from the information of a peripheral portion as disclosed in JP-A-1-15889.

The above conventional techniques, however, have problems such that it takes an extremely long time for arithmetic operating processes and processes are executed to the pixels of an image, so that a memory area remarkably increases, a dividing precision of a complicated area construction to the image is low, and the like.

In the conventional image processing apparatus, as area dividing means, there is used a method whereby a discrimination regarding whether an area is a table or another area is made on the basis of a ratio of the area of circumscribed rectangle and the number of pixels, and the area is divided on the basis of the result of the discrimination.

The above conventional technique, however, has a problem such that in the case where a separator or the like (modified separator) formed by complicated polygonal lines or the like is handled as one area, when the number of pixels for the area of the circumscribed rectangle increases, such an area is erroneously recognized as a table area and a dividing precision of the area decreases.

In the conventional image processing apparatus, in the case where the attributes (character, figure, table, etc.) of the divided area is erroneously discriminated, the area data which was erroneously discriminated is eliminated and a correct area frame is newly designated by a manual operation of the operator.

In a conventional technique such that the correction of the divided area is executed by a manual operation of the operator, in the case where a plurality of erroneous divided-areas exist, there is a problem such that a burden on the operator increases and a long time is needed as a ratio to the processing time of the whole image processes.

In such a kind of well-known image processing apparatuses, in the case where the image area was erroneously divided, area data of the erroneous area is eliminated and the operator newly designates the correct area frame by using a pointing device or the like.

The above conventional technique, however, has problems such that in case of a complicated area construction, a burden of the operation of the operator increases, it takes an extremely long time as a ratio to the processing time of the whole image processes, and the like.

SUMMARY OF THE INVENTION

In consideration of the above problems, an embodiment of the invention provides an image processing apparatus which can realize the reduction of the processing time when an area is divided, the decrease in size of a recording area, the improvement of a dividing precision of a complicated area construction, and the like. After an input image was thinned out, it is further converted into rectangle data by using a labeling and an area is divided into a character area and an area of a figure or photograph, a table, a separator, an index,.or the like. Therefore, there are effects such that without changing the existing electronic parts, circuits, and the like, (1) reduction in processing time, (2) decrease in size of a memory area or the like, (3) improvement of a dividing precision of a complicated area construction, and the like are obtained.

According to the invention, the input image is converted into the rectangle data and is classified into a character area and an area of a figure, photograph, table, separator, and the like and, further, partial histograms of the left and right edges in the vertical and horizontal directions of the area which was temporarily determined to be a table area are calculated and compared, thereby deciding whether the area is a table area or not. There are, consequently, effects such that without changing the existing electronic parts, circuits, or the like, (1) the improvement of the precision or the like is obtained for the division of a complicated area construction, particularly, the division of an area construction including a table, (2) the processing time is short because the histograms are partially obtained, and the like.

According to the invention, an input image is converted into rectangle data and is classified into a character area and an area of a figure or a photograph, table, separator, or the like, and further the rules in the vertical and horizontal directions of the area which was temporarily decided as a table area are detected

and counted, thereby deciding whether the area is a table area or not. Thus, there is an effect such that without changing the existing electronic parts, circuits, or the like, (1) the improvement of the precision or the like is obtained for the division of a complicated area construction, particularly, the division of an area construction including a table.

According to the invention, an input image is converted into rectangle data and is classified into a character area or an area of a figure or a photograph, table, separator, or the like, and a ratio of the area in a frame to the area of the area which was temporarily decided as a table area is obtained. When such a ratio is equal to or larger than a threshold value, the area is determined to be a table. Thus, there are effects such that without changing the existing electronic parts, circuits, and the like,

(1) the improvement of the precision or the like is obtained for the division of a complicated area construction, particularly, the division of an area construction including a table,
(2) since the area in the frame is used, even when the table frame slightly lacks, the decision about the table can be accurately performed,
(3) since the area in the frame is used, the decision about the table is strong for an inclination and can be accurately performed,
(4) and the like.

According to the invention, by combining the erroneously divided areas and correcting the erroneously presumed attributes, there are effects such that without changing the existing area dividing process, (1) an operating efficiency can be improved, (2) a processing time can be reduced, (3) and the like.

It is another object of the invention to provide an image processing apparatus which can combine erroneously divided areas by a simple operation and the attributes of each area can be also easily corrected.

By providing correcting means for integratedly combining special divided areas, the erroneously divided areas are combined and, further, the necessary area attributes can be corrected. Therefore, without changing the existing area dividing process, (1) an operating efficiency can be improved, (2) a processing time can be reduced, (3) and the like.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing a schematic construction of an image processing apparatus of an embodiment of the invention;

Fig. 2 is a flowchart showing a whole image processing procedure for the area division of an embodiment of the invention;

Fig. 3 is an explanatory diagram showing an example of a labeling process of an embodiment of the invention;

Fig. 4 is an explanatory diagram showing a structure of rectangle data in a memory unit of an embodiment of the invention;

Fig. 5 is comprised of Figs. 5A and 5B showing flowcharts of a processing procedure of a separator detector of an embodiment of the invention;

Fig. 6 is an explanatory diagram showing cutting processes based on a density D and an area S of the attributes of a rectangle (area) of an embodiment of the invention;

Fig. 7 is a flowchart showing a processing procedure of a writing direction detector of an embodiment of the invention;

Fig. 8 is an explanatory diagram showing an example of a detecting process of a paragraph of an embodiment of the invention;

Fig. 9 is a flowchart showing a processing procedure of an index detector of an embodiment of the invention;

Fig. 10 is an explanatory diagram showing an example of a combining process of rectangles of an embodiment of the invention;

Fig. 11 is an explanatory diagram showing an example of a combining process of separator rectangles of another embodiment of the invention;

Fig. 12 is a block diagram showing a schematic construction of an image processing apparatus of an embodiment 2;

Fig. 13 is a flowchart showing an image process in the image processing apparatus of the embodiment 2;

Fig. 14 is a diagram showing an example of a labeling process of the embodiment 2;

Fig. 15 is a diagram showing a rectangle data structure and the relation between the rectangle label and the attributes of the embodiment 2;

Fig. 16 is comprised of Figs. 16A and 16B showing flowcharts of a process of a separator detector of the embodiment 2;

Fig. 17 is a diagram showing cutting processes based on a density D and an area S of the attribute of a rectangle (area) of the embodiment 2;

Fig. 18 is a diagram showing a histogram when an area is determined to be a table area of the embodiment 2;

Fig. 19 is a diagram showing a histogram when an area is determined to be a modified separator area of the embodiment 2;

Fig. 20 is a flowchart showing an example of processes of a table area determiner of the embodiment 2;

Fig. 21 is a-diagram showing a histogram when an area is determined to be a modified separator area of the embodiment 2;

Fig. 22 is a flowchart showing an example of processes of the table area determiner of the embodiment 2;

Fig. 23 is a flowchart showing an image process in the image processing apparatus of the embodi-

ment 2;

Fig. 24 is a diagram showing a histogram when an area is determined to be a table area of the embodiment 2;

Fig. 25 is a diagram showing a histogram when an area is determined to be a modified separator area of the embodiment 2;

Fig. 26 is a flowchart showing an example of processes of a table rule detector and the table area determiner of the embodiment 2;

Fig. 27 is a flowchart showing an example of processes of the table area determiner of the embodiment 2;

Fig. 28 is a flowchart showing an example of processes of the table area determiner of the embodiment 2;

Fig. 29 is a diagram showing a table and rectangles showing areas of the table of the embodiment 2;

Fig. 30 is a-diagram showing the inside of a table and rectangles showing areas of the table of the embodiment 2;

Fig. 31 is a diagram showing a modified separator and rectangles showing an area of the modified separator of the embodiment 2;

Fig. 32 is a diagram showing the inside of a modified separator and rectangles showing an area of the modified separator of the embodiment 2;

Fig. 33 is a flowchart showing an example of processes of a table area determiner of the embodiment 2;

Fig. 34 is a diagram showing an area of a table and each pixel of the embodiment 2;

Fig. 35 is a block diagram showing a schematic construction of the image processing apparatus of the embodiment 2;

Fig. 36 is a flowchart showing an area division correcting process of the embodiment 2;

Fig. 37 is a diagram showing an example of the area division correcting process of the embodiment 2;

Fig. 38 is a diagram showing an area data structure of the embodiment 2;

Fig. 39 is a flowchart showing an area attribute correcting process of the embodiment 2;

Fig. 40 is a diagram showing an example of an area attribute correcting process display unit of the embodiment 2;

Fig. 41 is a block diagram showing a schematic construction of an image processing apparatus according to an embodiment 3;

Fig. 42 is a flowchart showing an area division correcting process of the embodiment 3;

Fig. 43 is a diagram showing an example of the area division correcting process of the embodiment 3;

Fig. 44 is a diagram showing an area data structure of the embodiment 3;

Fig. 45 is a flowchart showing an area attribute correcting process of the embodiment 3; and

Fig. 46 is a diagram showing an example of a display unit of the area attribute correcting process of the embodiment 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

(Embodiment 1)

The first embodiment of the invention will now be described hereinbelow with reference to Figs. 1 to 11.

Fig. 1 shows a schematic construction of an image processing apparatus of an embodiment of the invention. In the diagram, reference numeral 101 denotes an input unit of image data; 102 a central processing unit (CPU) to control the apparatus and execute an arithmetic operation of a process in each unit; 103 a memory to store control programs of flowcharts, which will be explained hereinlater, and various kinds of data; 104 an output unit to generate the results of the operating processes, the results of the image processes, and the image data; and 105 an area divider to execute a whole area dividing process.

An internal construction of the area divider 105 will now be described. First, reference numeral 106 denotes an image thinner to thin out an input image in a manner such that (m x n) pixels are thinned out by getting the OR of the vertical (m) dots and the horizontal (n) dots of the input image and one pixel is newly formed. Reference numeral 107 denotes a labeler for labeling the pixel obtained by the thinning-out process and for simultaneously forming initial rectangle data. That is, a label is added to the black pixels of the image for every line and the same label is added to the pixels which are continuous in the vertical, lateral, or oblique direction and, at the same time, a rectangle is traced. Reference numeral 108 denotes a separator detector to detect a separator, a table, a figure, or the like. By using the width of the above rectangle, height, area, and the number of pixels, namely, pixel density to the area, the separator detector 108 distinguishes a rectangle corresponding to a character portion (body), a rectangle corresponding to a figure or photograph, a rectangle corresponding to a table, a rectangle corresponding to a separator, and the like. Reference numeral 109 denotes a writing direction detector to detect the writing direction of a sentence such as vertical writing, horizontal writing, or the like. The writing direction detector 109 presumes a vertical writing sentence or a horizontal writing sentence by comparing the width and height of the rectangle corresponding to the character portion (body). Reference numeral 110 denotes an index detector to detect an index by using the writing direction and the character size. Reference numeral 111 denotes a rectangle combiner to combine rectangles by

using an imaginary rectangle which is obtained by enlarging the size of inherent rectangle.

A flowchart of Fig. 2 shows an image processing procedure in the area divider 105 in Fig. 1. A control program for executing the above image process has been stored in the memory 103.

(1) step S201

An original image is inputted from the image input unit 101.

(2) step S202

In the image thinner 106, the OR of the vertical (m) dots and the horizontal (n) dots of the original image is calculated and the (m x n) pixels are thinned out, thereby newly forming one pixel. When a black pixel of at least one dot exists in the (m x n) pixels of the original image, the thinned-out pixel is set to black.

(3) step S203

In the labeler 107, a label is added to the black pixel of the thinned-out pixel for every line and the same label is added to the pixels which are continuous in the vertical, lateral, or oblique direction and, at the same time, the rectangle is traced.

When explaining Fig. 3 as an example, a label 1 is added to the pixel (A) which is first detected. The coordinates (Xa, Ya) of the pixel A are set to an initial point and a terminal point of the rectangle, the number of pixels is set to 1, the same label 1 as that of the pixel is added to a rectangle label to distinguish the rectangle, and the above data is stored as rectangle data into the memory 103 as shown in Fig. 4.

A label 2 added to a pixel B in which there is no continuous pixel in the left direction (since the pixel B is located on the first line, there is also obviously no continuous pixel from the upper line). The coordinates (Xb, Yb) of the pixel B are set to an initial point and a terminal point of the rectangle, the number of pixels is set to 1, the same label 2 as that of the pixel is added to the rectangle label to distinguish the rectangle, and the above data is also stored as rectangle data into the memory 103 as shown in Fig. 4.

After the labeling of the first line was finished as mentioned above, the processes progress to the second line.

Since the first pixel C of the second line is continuous with the pixel A of the label 1 from the upper line, the pixel label 1 is added to the pixel C. "1" is added to the number of pixels for the rectangle data of the rectangle label 1, so that the total number of pixels is equal to 2, the rectangle label is unchanged and is maintained to 1, and only the terminal point of the rectangle coordinates is updated from (Xa, Ya) to (Xa, Yc) (the coordinate of the initial point is unchanged).

Since the next pixel D is continuous with the pixel C from the left, the label 1 is added to the pixel D. "1" is added to the number of pixels for the rectangle data of the rectangle label 1, so that the total number of pixels is set to 3. The rectangle label is maintained to 1 without being changed. Only the terminal point of the rectangle coordinates is updated from (Xa, Yc) to (Xd, Yc) (the Y coordinate of the terminal point is unchanged). In this instance, both of the pixels D and B are obliquely continuous and are continuous with the pixel C, so that the label of the pixel B is changed from the label 2 to the label 1. The number of pixels of the rectangle label 2 is added to that of the rectangle data of the rectangle label 1, so that the total number of pixels is set to 4. The rectangle label is maintained to 1 without being changed. Only the terminal point of the rectangle coordinates is updated from (Xd, Yc) to (Xb, Yd) so as to include all of the pixels A, B, C, and D. With respect to the rectangle data of the rectangle label 2, it is invalidated by setting the rectangle label into 0.

After the labeling of the second line was finished as mentioned above, the processes progress to the third line.

Since the first pixel E of the third line is obliquely continuous with the pixel C, the pixel label 1 is added to the pixel E. "1" is added to the number of pixels for the rectangle data of the rectangle label 1, so that the total number of pixels is set to 5. The rectangle label is maintained to 1 without being changed. As for the rectangle coordinates, the initial point is updated from (Xa, Ya) to (Xe, Ya) and the terminal point is updated from (Xb, Yd) to (Xb, Ye). Namely, in the rectangle data in Fig. 4 in the memory 103 in this instance, the rectangle label is set to 1, the initial point coordinates are set to (Xe, Ya), the terminal point coordinates are set to (Xb, Ye), the pixel label is set to 1, and the number of pixels is set to 5.

In a manner similar to the above, the labeling is executed to all of the thinned-out pixels and the tracing of the rectangle is performed.

(4) step S204

After completion of the above labeling and tracing of the rectangle, the separator detector 108 distinguishes a rectangle corresponding to the character portion (body), a rectangle corresponding to the figure, photograph, table, or the like, a rectangle corresponding to the separator, and the like by using the width W of the rectangle, height H, area S, and the number of pixels for the area, namely, the pixel density D (which can be easily obtained by calculating using those rectangle data). The above processes will now be described in detail hereinbelow with reference to flowcharts of Figs. 5A and 5B.

With respect to the separator, when the width W

is equal to or less than a threshold value Twl and the height H is equal to or larger than the value which is twice as large as a threshold value Tw2 of the width W (step S503) or when the width W is larger than the threshold value Twl and the height H is equal to or larger than the value which is three times as large as a threshold value Tw3 of the width W (step S504), the separator is regarded as a separator which is vertically long and is unified by setting the rectangle label in the memory 103 into -3 and the pixel label constructing the rectangle keeps the current label number separately from the rectangle label (step S514).

A rectangle in which the above width and height were replaced is also judged in a manner similar to the above (steps S505, S506). If YES in each of the steps S505 and S506, the separator is regarded as a separator which is horizontally long and the rectangle label is changed to -3.

As shown in Fig. 6, if NO in all of steps S503 to S506 and when the pixel density D is equal to or less than a threshold value Tdl (step S507), the separator is regarded as a modified separator such as a key-shape or the like and the rectangle label is set to -3 (step S514).

If NO in step S507 and when the area S is larger than a threshold value Tsl (step S508), so long as the pixel density D is less than a threshold value Td2 (step S509), the rectangle is regarded as a table and the rectangle label is changed to -4 (step S515). When the pixel density D is equal to or larger than the threshold value Td2, the rectangle is regarded as a figure or photograph and the rectangle label is changed to -5 (step S516).

A rectangle in which the pixel density D is equal to or larger than a threshold value Td3 (step S511) when the area S is equal to or less than the threshold value Ts1 and is equal to or larger than a threshold value Ts2 (step S510) or a rectangle in which both of the width W and the height H are equal to or larger than a threshold value Tw4 and the pixel density D is equal to or larger than a threshold value Td5 (step S513) is also regarded as a figure or photograph and the rectangle label is changed to -5 (step S516).

Further, a rectangle in which the pixel density D is less than a threshold value Td4 (step S512) when the area S is equal to or less than the threshold value Ts1 and is equal to or larger than the threshold value Ts2 (step S510) is regarded as a table and the rectangle label is changed to -4 (step S515).

As mentioned above, a rectangle corresponding to a figure, photograph, table, or the like, a rectangle corresponding to a separator, or the like is detected, the remaining rectangle is regarded as a body (character portion), and the rectangle label is unchanged and is set to the same label as the pixel label (step S517). Fig. 6 shows the relation between the above threshold values in case of the area S and pixel density D and the classification of the separator or the like.

(5) step S205

In the writing direction detector 109 detects the writing direction of a sentence such as vertical writing, horizontal writing, or the like. The writing direction detecting process will now be described with reference to a flowchart of Fig. 7.

In case of a horizontal writing sentence, the rectangle remaining as a body easily becomes a rectangle which is laterally long because the pixels which were thinned out in the lateral direction are continuous. In case of a vertical writing sentence, the rectangle remaining as a body easily becomes a rectangle which is vertically long. Therefore, in the writing direction detector 109, the average values (w and h) of the width W and height H of the rectangle of the body are calculated (step S701). When the average width w is larger than the average height h, the sentence is regarded as a sentence having a large amount of horizontal writing sentences and the average height h is set to a character size of one character (steps S702, S703). On the contrary, when the average height h is larger than the average width w, the sentence is regarded as a sentence having a large amount of vertical writing sentences and the average width w is set to a character size of one character (steps S702, S710).

As shown in Fig. 8, a histogram of rectangles is obtained in the direction opposite to the writing direction (steps S704, S711). A position below a threshold value Tk is set to a separation of a paragraph from the shape of a peripheral distribution (steps S705, S712). A histogram of the rectangles is obtained every paragraph in the same direction as the writing direction (steps S708, S715). A length of continuous black pixels is set to a character size within the paragraph from the shape of the peripheral distribution and a length of continuous white pixels is detected as a line pitch (steps S709, S716). The above detecting process is repeated until the end of the paragraph (steps S706, S713).

(6) step S206

In the index detector 110, an index is detected from the writing direction and the character size. As shown in a flowchart of Fig. 9, when considering the case of the vertical writing as an example, a rectangle whose width W is equal to or larger than the value of a threshold value Tml X the character size w is detected as a candidate of the index rectangle from the body rectangle (step S905). Further, when the height H of rectangle is smaller than the value of (a threshold value Tm2) times of the character size w (step S906), a sentence is regarded as a sentence in which the horizontal written characters are continuous and such

a sentence is regarded as an index (step S908).

Since there is a case where a rectangle in which characters of a body were combined is also included in the rectangles which were regarded as indices from the size of rectangle as mentioned above, with respect to the rectangle in which the distance between the body rectangle and the index rectangle is closer than a threshold value T1 (step S907), it is corrected from the index to the body (step S909).

Among the body rectangles remaining by the above processes, a rectangle such that none of the rectangles of the body and index exists within a range of the character size w is set into an index as an isolated rectangle (steps S910 to S913).

(7) step S207

In the rectangle combiner 111, the rectangles corresponding to the bodies which exist at random without any relation and the rectangles of the indices are combined.

An example is shown in Fig. 10. The combination of rectangles A1 and B will now be considered. An imaginary rectangle A1' which is obtained by enlarging the rectangle A1 by only Px in the X direction and by only Py in the Y direction is now considered. The periphery of the rectangle A1' is searched to see if there is a rectangle which is come into contact with or is inscribed in the rectangle A1' or not. When a rectangle which is in contact with A1' exists like a rectangle B, by combining the rectangles A1 and B, a combined rectangle A2 is newly formed. By updating the rectangle data of the rectangle A1, the updated data is stored and the data of the rectangle B is invalidated. In this instance, the values of Px and Py are obtained from the character size and line pitch. In the case where the rectangle formed by combining the rectangles is come into contact with a figure, table, separator, or the like, the combining process itself is invalidated and the original rectangles are maintained as they are.

As mentioned above, the indices are first combined and the body rectangles are subsequently combined. In this instance, in case of combining the bodies, it is prevented that the rectangle is come into contact with not only a figure, table, or separator but also an index. When the rectangle is come into contact with the index, the combining process itself is invalidated and the original rectangles are maintained as they are.

(8) step S208

Finally, the rectangle data of various kinds of areas obtained as mentioned above is generated from the output unit 104 to the outside together with the image data.

In the image inputting process in step S201 in Fig. 2 mentioned above, by judging whether the input image has multivalues or not and by converting the input image into a binary image, the area dividing process can be also executed even when the input image is a multivalue image such as a color image or the like.

In the image thinning process in step S202, when the number of pixels of the input image is sufficiently small to be a value which doesn't decrease the processing speed, such an image thinning process can be also omitted.

In the detection of a separator or the like in step S204, by distinguishing the rectangle label in dependence on a difference between the vertical and lateral directions of the separator, a difference between the threshold values when obtaining a figure, table, or the like, etc., the further fine area attributions can be classified.

Likewise, in the detection of a separator or the like in step S204, in the case where only an image of a special attribute is inputted from the beginning like only a sentence or the like, the detecting process of a separator or the like can be also omitted.

In the detection of the writing direction in step S205, in place of obtaining the average width and average height, by obtaining the most frequent values, those values can be also used.

Similarly, in the detection of the writing direction in step S205, by again confirming the writing direction every paragraph, the processes can be also accurately executed to an original in which the vertical writing sentences and the horizontal writing sentences mixedly exist.

In the detection of the writing direction in step S205, when only the sentences in a predetermined writing direction are inputted from the beginning, by setting the writing direction to a fixed value, such a detecting process can be replaced.

In the index detection in step S206, when only the image having no index is inputted from the beginning, such a detecting process can be also omitted.

In the combining process of the rectangles in step S207, as shown in Fig. 11, when a rectangle is come into contact with a rectangle such as a separator or the like, a check is further made to see if the rectangle is also in contact with the actually thinned-out pixel or not, and when the rectangle is not in contact with such a pixel, by executing the combining process, the apparatus can also cope with a slanted image.

Likewise, in the combining process of rectangles in step S207, in case of an image such that the number of pixels is so small that the image thinning process can be omitted, such a combining process can be also omitted.

In the last outputting process in step S208, only the image data of a necessary area can be also generated with reference to the rectangle data of various kinds of areas, so that the memory area and the processing time can be further reduced.

(Embodiment 2)

A preferred second embodiment of the invention will now be described with reference to Figs. 12 to 40.

Fig. 12 is a block diagram showing an image processing apparatus of the embodiment.

In the diagram, reference numeral 101 denotes the input unit of image data.

Reference numeral 102 denotes the central processing unit (CPU) to control the apparatus and execute an arithmetic operation of the process in each unit in accordance with the control programs stored in the memory 103.

Reference numeral 103 denotes the memory to store the control programs as shown in flowcharts, which will be explained hereinlater, and various kinds of data. The memory 103 includes an ROM and an RAM.

Reference numeral 104 denotes the output unit to generates the results of the arithmetic operating processes, the results of the image processes, and image data.

Reference numeral 105 denotes the area divider showing the whole area dividing process.

Reference numeral 107 denotes the labeler for adding a label to the pixels of the input image and for simultaneously forming initial rectangle data.

Reference numeral 207 denotes an attribute detector to detect the attribute of a separator, a table, a figure, or the like.

Reference numeral 208 denotes a table rule detector to detect straight lines constructing a table.

Reference numeral 209 denotes a table area determiner to determine whether an area is a table area or not from a state of the table rules.

Fig. 13 is a flowchart showing the image process in the image processing apparatus of the embodiment. The control programs to execute the image process have been stored in the memory 103.

(step S201)

The original image is first inputted from the image input unit 101.

(step S202)

In the labeler 107, the labels are added to the black pixels of the thinned-out image for every line and the same label is added to the pixels which are continuous in the vertical, lateral, and oblique directions, thereby simultaneously tracing a rectangle.

When explaining Fig. 14 as an example, the label 1 is added to the pixel A which is first detected. The coordinates (Xa, Ya) of the pixel A are set to an initial point and a terminal point of the rectangle, the number of pixels is set to 1, the same label is as that of the pixels is added to the rectangle label to distinguish the rectangle, and the above data is stored into the memory as rectangle data (Fig. 15).

Subsequently, the label 2 is added to the pixel B such that there is no continuous pixel in the left direction (since the pixel B is located on the first line, there is also no continuous pixel from the upper line). The coordinates (Xb, Yb) of the pixel A are set to an initial point and a terminal point of the rectangle. The number of pixels is set to 1 and the same label 2 as that of the pixels is added to the rectangle label to distinguish the rectangle. The above data is also stored into the memory as rectangle data (Fig. 15).

After completion of the labeling of the first line as mentioned above, the processes progress to the second line.

Since the first pixel C of the second line is continuous with the pixel A of the label 1 from the upper line, the pixel label 1 is added to the pixel C. "1" is added to the number of pixels for the rectangle data of the rectangle label 1, so that the total number of pixels is set to 2. The rectangle label is maintained to 1 without being changed. Only the terminal point of the rectangle coordinates is updated from (Xa, Ya) to (Xa, Yc) (the coordinates of the initial point are unchanged).

Since the next pixel D is continuous with the pixel C from the left side, the label 1 is added. "1" is added to the number of pixels for the rectangle data of the rectangle label 1, so that the total number of pixels is set to 3. The rectangle label is maintained to 1 without being changed. Only the terminal point of the rectangle coordinates is updated from (Xa, Yc) to (Xd, Yc) (the Y coordinate of the end point is unchanged).

In this instance, the pixel D is also obliquely continuous with the pixel B and continuously comes from the pixel C, so that the label of the pixel B is changed from the label 2 to the label 1. The number of pixels of the rectangle label 2 is added to that of the rectangle data of the rectangle label 1, so that the total number of pixels is set to 4. The rectangle label is maintained to 1 without being changed. Only the terminal point of the rectangle coordinates is updated from (Xd, Yc) to (Xb, Yd) so as to include all of the pixels A, B, C, and D. The rectangle data of the rectangle label 2 is invalidated by setting the rectangle label into 0.

After completion of the labeling for the second line as mentioned above, the processes progress to the third line.

Since the first pixel E of the third line is obliquely continuous with the pixel C, the pixel label 1 is added and "1" is added to the number of pixels for the rectangle data of the rectangle label 1, so that the total number of pixels is set to five. The rectangle label is maintained to 1 without being changed. The initial point of the rectangle coordinates is updated from (Xa, Ya) to (Xe, Ya) and the terminal point is updated from (Xb, Yd) to (Xb, Ye).

In a manner similar to the above, the labeling and

tracing of the rectangle are executed for all of the thinned-out pixels.

(step S203)

In the attribute detector 207, after completion of the labeling and the tracing of the rectangle, a rectangle corresponding to the body, a rectangle corresponding to a figure, photograph, table, or the like, a rectangle corresponding to a separator, and the like are distinguished by using the width W of the rectangle, height H, area S, and the number of pixels for the area, namely, the pixel density D (those data can be easily obtained by calculating the rectangle data).

When the width W is equal to or less than the threshold value Tw1 and the height H is equal to or larger than (the threshold value Tw2) times of the width W (S503 in Fig. 16A), or when the width W is larger than the threshold value Twl and the height H is equal to or larger than (the threshold value Tw3) times of the width W (S504 in Fig. 16B), the separator is regarded as a separator which is vertically long and is unified by setting the rectangle label to -3, and the pixel labels constructing the rectangle is maintained as it is separately from the rectangle label (S514 in Fig. 16B).

In a manner similar to the above separator in which the width and height were replaced (S505 and S506 in Fig. 16A), the separator is regarded as a separator which is horizontally long and the rectangle label is changed to -3.

As shown in Fig. 17, when the pixel density D is equal to or less than the threshold value Tdl (S507 in Fig. 16B), the separator is regarded as a modified separator such as key-shaped or the like and the rectangle label is changed to -3 (S514 in Fig. 16B).

When the area S is larger than the threshold value Tsl (S508 in Fig. 16B), so long as the pexel density D is less than the threshold value Td2 (S509 in Fig. 16B), the area is regarded as a table and the rectangle label is changed to -4 (S515 in Fig. 16B). When the pexel density D is equal to or larger than the threshold value Td2, the rectangle is regarded as a figure or photograph and the rectangle label is changed to -5 (S516 in Fig. 16B).

A rectangle when the pixel density D is equal to or larger than the threshold value Td3 (S511 in Fig. 16) when the area S is equal to or less than the threshold value Tsl and is equal to or larger than the threshold value Ts2 (S510 in Fig. 16B) or a rectangle when the width W and height H are equal to or larger than the threshold value Tw4 and the pixel density D is larger than Td5 (S513 in Fig. 16B) is also regarded as a figure or a photograph, and the rectangle label is changed to -5 (S515 in Fig. 16B).

Further, when the area S is equal to or less than the threshold value Ts1 and is equal to or larger than the threshold value Ts2 (S510 in Fig. 16B), a rectangle in which the pixel density D is less than a threshold value Td4 (S512 in Fig. 16B) is regarded as a table and the rectangle label is changed to -4 (S515 in Fig. 16B).

In a manner similar to the above, a rectangle corresponding to a figure, photograph, table, or the like, a rectangle correspond to the separator, and the like are detected, and the remaining rectangles are regarded as bodies and the rectangle label is maintained and is set to the same pixel label (S517 in Fig. 16B).

(step S204)

Subsequently, in the table area determiner 208, a width when calculating a histogram is decided from the width W and height H of the rectangle which was determined to be a table area (S901 in Fig. 20).

Partial histograms of the left and right edges in the vertical and horizontal directions are calculated (S902 in Fig. 20) for only the pixels (701 in Fig. 18, 801 in Fig. 19) (they can be easily obtained by comparing and selecting the pixel label of the rectangle data and the pixel label of each pixel in the rectangle) corresponding to the table frame excluding the bodies (702 in Fig. 18, 802 in Fig. 19) or the like in the rectangle which was determined to be a table area. A threshold value Tkh of a histogram regarding whether a line is a table frame line which is parallel with the Y axis or not from the height of the rectangle and a threshold value Tkw of a histogram regarding whether a line is a table frame line which is parallel with the X axis or not from the width of rectangle are determined (S903, S904 in Fig. 20).

In the case where the portions corresponding to the table frame line-exist at the left and right edges of both of the partial histograms in the horizontal and vertical directions (namely, in the case where frame lines of the table exist at the left and right edges and the top and bottom edges of the rectangle), the corresponding rectangle is determined to be a table area (S905, S906, S908 in Fig. 20).

In the case where the portion corresponding to the table frame line lacks even at one of the left and right edges of both of the partial histograms in the horizontal and vertical directions (namely, even either one of the left and right edges or even either one of the upper and lower edges lacks), the corresponding rectangle is determined as a modified separator area (S905, S906, and S907 in Fig. 20).

(step S205)

Finally, the rectangle data of various kinds of areas which was obtained as mentioned above is generated from the output unit 104 together with the image data.

In the image input in step S201, by judging

whether the input image is a multivalue image or not and converting the input image into the binary image, the area dividing process can be executed even when the input image is a multivalue image such as a color image.

In the image input in step S201, when the number of pixels of the input image is so large that an extremely long processing time is necessary, the processing speed can be raised by the image t-hinning process for thinning out the image of (m dots in the vertical direction) x (n dots in the horizontal direction), thereby newly forming one pixel.

In the detection of a separator or the like in step S203, by distinguishing the rectangle labels by a difference between the vertical and horizontal directions of the separator, a difference between the threshold values when obtaining a figure, a table, or the like, etc., the further detailed area attributes can be also classified.

In the determination of the table area in step S204, as shown in Figs. 21 and 22, a difference Sx between the histograms at the left and right edges and a difference Sy between the histograms at the upper and lower edges are respectively obtained. When either one of the differences is equal to or larter than a threshold value Ts, it is decided that the lengths of rules are not uniform, so that it is determined that the area is a modified separator area. When either one of the differences is less than the threshold value Ts, it is decided that the area is a table area. By such a method, they can be replaced.

In the last output in step S206, only the image data of the necessary area can be also generated with reference to the rectangle data of various kinds of areas. The memory area and the processing time can be further reduced.

In the above description, the histograms of the upper, lower, right, and left edges of the area whose attribute was judged as a table have been used as a method of determining the table area. An explanation will now be made with respect to an example in which histograms of the whole area which was determined to be a table are obtained and the rules are detected and the table area is decided on the basis of the number of rules.

The process in the above example is shown in a flowchart of Fig. 23. Processing steps similar to those in the flowchart of Fig. 13 described before are designated by the same step numbers and their descriptions are omitted here.

(step S1204)

Subsequently, in the table rule detector 208, histograms are calculated in the vertical and horizontal directions (S1501 in Fig. 26) for only the pixels (701 in Fig. 24, 801 in Fig. 25) (they can be easily obtained by comparing and selecting the pixel label of the rectangle data and the pixel label of each pixel in the rectangle) corresponding to the table frame excluding the bodies or the like (702 in Fig. 24, 802 in Fig. 25) in the rectangle which was determined to be a table area. The threshold value Tkh of the histogram regarding whether the rules are parallel with the Y axis or not from the height of rectangle and the threshold value Tkw of the histogram regarding whether the rule is parallel with X axis or not from the width of rectangle are obtained (S1502 and S1503 in Fig. 26).

The position of the threshold value Tkh or more is regarded as a rule of the table area from the shape of the histogram in the vertical direction (S1504 in Fig. 26). The position of the threshold value Tkw or more is similarly regarded as a rule of the table area from the shape of the histogram in the horizontal direction (S1505 in Fig. 26).

(step S1205)

The number Nx of vertical rules obtained from the histogram in the vertical direction while regarding the portions of the threshold value Tkh or more as rules is stored. The number Ny of horizontal rules obtained from the histogram in the horizontal direction while regarding the portions of the threshold value Tkw or more as rules is stored. When three or more vertical rules and three or more horizontal rules exist, the area is determined to be a table area (S1506, S1508, S1509 in Fig. 26). When the number of rules is less than three, the area is decided to be a modified separator area (S1506, S1508, S1507 in Fig. 26).

(step S1206)

Finally, the rectangle data of various kinds of areas obtained as mentioned above is generated from the output unit 104 together with the image data.

In the image input in step S201, by judging whether the input image is a multivalue image or not and by converting the input image into the binary image, the area dividing process can be performed even when the input image is a multivalue image such as a color image.

In the image input in step S201, when the number of pixels of the input image is so large that an extremely long processing time is necessary, the processing speed can be also raised by the image thinning process for thinning out the image of (m dots in the vertical direction) x (n dots in the horizontal direction), thereby newly forming one pixel.

In the detection or the like of a separator in step S203, by distinguishing the rectangle labels by a difference between the vertical and horizontal directions of the separator, a difference between the threshold values when obtaining a figure, a table, or the like, etc., the further detailed area attributes can be also classified.

In the table rule detection in step S1204, when it is known that the inclination of the image after it was

inputted is small, by tracing the lines in place of calculating a histogram, the table rules can be also detected.

In the table area determination in step S1205, in place of fixing the threshold value TN to decide whether the area is a table area or not, as shown in Fig. 27, the area of rectangle is compared with a threshold value S1 and the preset number of rules is compared with threshold values Tn1 (area ≧ S1) and Tn2 (area < S1). When the rules of the threshold values or more exist, the area is determined to be a table area. When the number of rules is less than the threshold values, the area is decided as a modified separator area. Due to this, they can be replaced.

Further, as shown in Fig. 28, the threshold values which were determined in correspondence to the magnitude of the area of the rectangle which was temporarily determined as a table area are decided on the basis of the width and height of the rectangle and are respectively set to W1 and H1. A threshold value of the number of vertical rules is set to TnH. A threshold value of the number horizontal rules is set to TnW. By such a method, they can be also replaced.

In the last output in step S1206, only the image data of the necessary area can be also generated with reference to the rectangle data of the various kinds of areas. The memory area and processing time can be further reduced.

The method of obtaining the histogram of the area whose attribute was determined to be a table area has been used as a method of determining the table area in the above description. Explanation will now be made with respect to an example in which the table area is determined by the ratio of the area in the table frame to the area of the area which was decided to be a table area.

The process in this example is as shown in the flowchart of Fig. 13 except that the process in step S204 differs from that in Fig. 13. Step S204, therefore, will now be described.

(step S204)

Subsequently, in the table area determiner 208, a table area is decided. Fig. 33 is a flowchart for explaining in detail the determining process of the table area in step S204. The determining process will now be described hereinbelow with reference to the flowchart of Fig. 33.

First, in step S221, an outline of an outer frame of a table is traced and point coordinates constructing the outline are stored.

Fig. 34 is a diagram for explaining the processes in steps S221 to S223.

In Fig. 34, reference numeral 2301 denotes a (very small) rectangle area which was determined to be a table; a white circle indicates a white pixel; a black dot denotes a black pixel; and a gray dot indicates a pixel which belongs to the inside of the table although it is a white pixel.

The black pixels or the like by characters in the table are omitted.

First, the inside within the table area is observed every line from the top and from the left side, thereby searching the black pixels constructing the table frame. When the black pixel is found out, its coordinates are stored into the memory 103. In the example of the area 2301, the table area is observed in the direction from the coordinates (0, 1) to the coordinates (10, 1) to see if there is a black pixel exists or not every pixel. Since the black pixel exists at the position of the coordinates (2, 1), the coordinates are stored into the memory 103.

Subsequently, the outline is traced clockwise or counterclockwise from the black pixel and the coordinates of the black pixels (hereinafter, referred to as outline points) constructing the outline are stored into the memory 103. In the example of the area 2301, the coordinates up to (2, 1) - (10, 1), (10, 1) - (10, 11), (10, 11) - (1, 11), (0, 10) - (0, 4), and (1, 4) - (1, 2) are stored as outline points into the memory 103.

In step S222, the number of pixels which belong to the inside of the table is counted every horizontal line and added. In this case, two points at the rightmost edge and leftmost edge of the outline points stored in the memory 103 in step S221 are extracted for every line. The distance between the two extracted points is added as the number of pixels belonging to the inside of the table. This process can be shown by the following equation.

(x coordinate of the right edge) - (x coordinate of the left edge) + 1 = (the number of pixels in the table)

By the above method, even when the outline is complicated or the table frame lacks, the area in the table can be easily and rapidly obtained. Although such a process is sufficient as a determining process which is executed in the table area determiner 208, the area in the table can be also obviously accurately obtained.

In the example of the area 2301 in Fig. 34, the line whose y coordinate is equal to 1 as the top horizontal line will now be considered. On the line of y = 1, the coordinates of the outline point of the leftmost edge are set to (2, 1). The coordinates of the outline point of the rightmost edge are set to (10, 1). Therefore, the number of pixels in the table is

$$10 - 2 + 1 = 9$$

In step S223, a check is made to see if the numbers of pixels have been counted with respect to all of the lines in the table area or not. If YES, step S224 follows. When the line in which the number of pixels is not yet counted still remains, the processing routine is returned to step S222 and the processes are continued.

In the example of the area 2301, since the count-

ing operations regarding all of the lines are not yet finished, the processing routine is returned to step S222 and the processes are executed for the line of y = 2. In the line of y = 2, the coordinates of the outline point of the leftmost edge are set to (1, 2) and the coordinates of the outline point of the rightmost edge are set to (10, 2).

Therefore, the number of pixels in the table is

$$10 - 1 + 1 = 10$$

This number is added to the number (9) of pixels calculated with respect to the line of y = 1, so that the total number of pixels is equal to 19.

Similarly, in the example of the area 2301, the above processes are executed up to the line of y = 11. Thus, the number of pixels in the table is

$$9 + 10 + 10 + 11 + 11 + 11 + 11 + 11 + 11 + 11 + 10 = 116$$

In step S224, a ratio of the area S_{frame} in the frame to the area S_{table} of the rectangle area which was determined to be a table area is obtained.

In step S225, a check is made to see if the ratio of the area in the frame is larger than a threshold value or not. Namely, when the following relation is satisfied,

(area S_{frame} in the frame) $\div$ (area S_{table} of the rectangle area which was decided to be a table area) > (threshold value γ)

the relevant rectangle is determined to be a table area in step S226. The processing routine advances to step S205. When the above relation is not satisfied, in step S227, the relevant rectangle is decided to be a modified separator area and the rectangle label of the relevant rectangle stored in the memory 103 is changed to -3. After that, step S205 follows. The threshold value γ is set to γ = 0.9 here.

In the example of the area 2301,

(area in the frame) = 9 + 10 + 10 + 11 + 11 + 11 + 11 + 11 + 11 + 11 + 10 = 116

(area of the rectangle area which was determined to be a table area) = 11 x 11 = 121

Therefore, 116 $\div$ 121 = 0.959 > 0.9 and the following relation is satisfied.

(area in the frame) $\div$ (area of the rectangle area which was decided to be a table area) > (threshold value γ)

Therefore, the area 2301 is determined to be a table area and step S205 follows.

Similarly, in the example shown in Fig. 18, the inside of the table surrounded by a frame 702 is expressed like a black portion 801 in Fig. 19 and the ratio of the area in the frame is larger than the threshold value γ, so that such a portion is determined to be a table and step S205 follows.

In Fig. 29, reference numeral 701 denotes the rectangle area which was determined to be a table; 702 the frame; and 703 a line of a horizontal writing sentence.

Similarly, in the example shown in Fig. 31, the inside of the table surrounded by a frame 902 is shown like a black portion 1001 in Fig. 32 and the ratio of the area in the table frame is smaller than the threshold value y, so that such a portion is determined to be a modified separator.

In Fig. 31, reference numeral 901 denotes a rectangle area which was decided to be a table; 902 the frame; and 903 a line of a vertical writing sentence.

In the table area determination in step S204, although the number of pixels belonging to the inside of the table has been counted every horizontal line and added in step S222, it is also possible to count and add the number of pixels belonging to the inside of the table for every vertical line.

In the table area determination in step S204, although the number of pixels belonging to the inside of the table has been counted and added for every horizontal line in step S222, the table area determining process can be performed irrespective of the execution of the operation to count the number of black pixels constructing the sentence in the frame in this instance.

In the table area determination in step S204, the number of pixels belonging to the inside of the table has been counted and added every horizontal line in step S222 and the area in the frame has been calculated. However, the table area determining process can be executed even when the area in the frame is obtained by any other means.

In the last generation in step S205, only the image data of the necessary area can be also generated with reference to the rectangle data of various kinds of areas. The memory area and the processing time can be further reduced.

For example, a process to correct the areas which were divided and obtained by the method as mentioned above and the attributes of those areas will now be described.

Fig. 35 is a block diagram showing a construction of the image processing apparatus of the embodiment.

In Fig. 35, constructions shown by reference numerals 101 to 105 are substantially the same as those shown in Fig. 12 and their descriptions are omitted here.

Reference numeral 117 denotes a display unit for overlapping the results divided by the area divider 105 to the original image data, for displaying a frame, and for displaying a list of attributes or the like.

Reference numeral 112 denotes an area division corrector to correct the erroneous division of the areas divided by the area divider 105.

Reference numeral 113 denotes an area attribute corrector to correct the area attribute which was presumed by the area divider 105.

Fig. 36 is a flowchart showing an area division correcting process in the image processing apparatus of the embodiment. A control program to execute

the area division correcting process has been stored in the memory 103.

Fig. 39 is a flowchart showing an area attribute correcting process in the image processing apparatus of the embodiment. A control program to execute this process has been stored in the memory 103.

(1) The case where the area which should inherently be one area was erroneously divided into a plurality of areas:

In the division corrector 112, a plurality of areas which were erroneously divided by the area divider 105 are indicated by surrounding them by a frame (301 in Fig. 37) by using a pointing device or the like (S2501 in Fig. 36). In this instance, the corresponding area frames (areas A, B, and C in Fig. 37) are shown by changing a display line from the solid lines to the dotted lines (S2503 in Fig. 36).

When an area exceeding the designated frame exists, the designated frame is invalidated and erased and the processing routine is returned to the first step (S2502 in Fig. 36).

When all of the areas exist within the designated frame, the area data (coordinates, attribute, and the like in Fig. 38) of all of the areas in the frame surrounded by the frame are preserved in the memory 103 (S2504 in Fig. 36). At the same time, a list table for setting new area attributes (303 in Fig. 37) is displayed (S2505 in Fig. 36).

By selecting the attributes of the new area from the list table (S2506 in Fig. 36), the new attributes are reversed and displayed (S2507 in Fig. 36). When the new attributes are determined (S2508 in Fig. 36), either one of a plurality of areas existing in the designated frame is unconditionally selected and the coordinates, attributes, and the like of the area data are changed (S2509 in Fig. 36). The other remaining area data is invalidated (S2510 in Fig. 36). A new area frame (302 in Fig. 37) is displayed (S2511 in Fig. 36).

A plurality of areas are combined to one area by the above operation.

In the case where the attributes of the area are wrong:

In the attribute corrector 113, in the case where the operator wants to change only the attributes of the area data which was presumed by the area divider 105, only a target area (602 in Fig. 40) is designated by surrounding by a frame (603 in Fig. 40) by using a pointing device or the like (S2801 in Fig. 39) and a list table (601 in Fig. 40) of the attributes is displayed (S2802 in Fig. 39). In this instance, the current attributes are reversed and displayed (S2803 in Fig. 39) and the relevant area frame is changed from the solid line to the dotted line (602 in Fig. 40) (S2804 in Fig. 39).

By selecting the attributes to be changed from the list table (S2805 in Fig. 39), the reversed display of the original attributes is erased and the new attributes are reversed and displayed (S2806 in Fig. 39) and the attributes of the area data are also simultaneously changed (S2807 in Fig. 39).

In the division corrector 112, in place of designating the area by using the pointing device or the like, the area can be also designated by vertically or horizontally moving a cursor by using a key on a keyboard.

In place of showing a fact that a plurality of areas were selected by the designated frames by displaying using the dotted lines, such a fact can be also shown by changing the display color of the area frame.

The area data structure can include not only the data shown in the example of Fig. 38 but also data such as the number of pixels in the area, writing direction of the sentence, or the like.

It is also possible to first execute only the combining process of the areas and to independently perform the attribute detecting process of the area later.

In the attribute corrector 113, in place of displaying the current attributes in the attribute list table by the reversing display, they can be also shown by changing the display color.

In place of displaying the relevant area frame by changing from the solid line to the dotted line, it can be also shown by changing the frame color.

In place of displaying the list table of attributes, by displaying only the current attributes and by changing the attribute display portion by instructing using the pointing device or the like or by providing a display change switch, and by repeating such a changing process until desired attributes are displayed, the attributes can be also changed.

(Embodiment 3)

A preferred third embodiment of the invention will now be described with reference to Figs. 41 to 46.

Fig. 41 is a block diagram showing an image processing apparatus according to the third embodiment of the invention.

In the diagram, reference numeral 101 denotes the input unit of image data. Reference numeral 102 denotes the central processing unit (CPU) to control the apparatus in accordance with the control programs stored in the memory 103 and to execute processing arithmetic operations in each section.

Reference numeral 103 denotes a memory to store control programs and various kinds of data, which will be explained hereinlater, are stored.

Reference numeral 105 denotes the area divider to divide the area and to presume the attributes of the area.

Reference numeral 117 denotes the display unit for overlapping the results divided by the area divider 105 to the original data and displaying frames, thereby displaying a list table or the like of the attributes.

Reference numeral 112 denotes the division collector to correct the erroneous division of the areas

divided by the area divider 105.

Reference numeral 113 denotes the attribute corrector to correct the area attributes which were presumed by the area divider 105.

Reference numeral 104 denotes the output unit to generate the results of the arithmetic operations, the results of the image processes, and image data.

Fig. 42 is a flowchart showing the area division correcting process in the image processing apparatus of the embodiment. The control program to execute the above processes have been stored in the memory 103.

Fig. 45 is a flowchart showing an area attribute correcting process in the image processing apparatus of the embodiment. The control program to execute this process has been stored in the memory 103.

The correcting process in the case where an area which should inherently be one area was erroneously divided into a plurality of areas will now be described with reference to Fig. 42.

In the division corrector 112, one of a plurality of areas which were erroneously divided by the area divider 105 is designated and selected as a key area by the pointing device or the like (S201 in Fig. 42). The area data (coordinates, attributes, etc.: refer to Fig. 44) of the key area (refer to an area A in Fig. 43) is preserved in the memory 103 (S202 in Fig. 42).

Another divided area (refer to an area B in Fig. 43) is designated by the pointing device or the like (S203 in Fig. 42). The area data (coordinates, attributes, etc.) of such an area is preserved into the memory 103 (S204 in Fig. 42).

In this instance, a fact that those two areas were selected is shown by displaying a line segment (refer to a line segment in Fig. 43) connecting the designated points in both areas (S205 in Fig. 42). A check is made to see if another area exists between the two areas or not (S206 in Fig. 42). If NO, those two areas are combined and the area data of the area B is invalidated (S207 in Fig. 42). The coordinates of the area data of the key area are updated (however, the attributes are not changed) (S208 in Fig. 42). Consequently, the attributes of a new area (refer to an area C in Fig. 43) obtained by combining the two areas are the same as the attributes of the key area.

In the case where another area exists between the two areas, the combining process is stopped (S209 in Fig. 42).

By repeating the above operation, a plurality of areas can be combined to one area.

The correcting process in the case where the attributes of an area are wrong will now be described with reference to Fig. 45.

In the attribute corrector 113, in the case where the operator wants to change only the attributes of the area data which was presumed by the area divider 105, a target area (refer to 602 in Fig. 46) is continuously designated twice by the pointing device or the like (S501 in Fig. 45) and the list table of the attributes (refer to 601 in Fig. 46) is displayed (S502 in Fig. 45). In this instance, the current attributes are reversed and displayed (S503 in Fig. 45) and the relevant area frame is displayed by changing from the solid line to the dotted line (refer to 602 in Fig. 46) (S504 in Fig. 45).

By subsequently selecting the attributes which the operator wants to change from the list table (S505 in Fig. 45), the reversed display of the original attributes is erased and the new attributes are reversed and displayed (S506 in Fig. 45) and the attributes of the area data are also simultaneously updated (S507 in Fig. 45).

In the division corrector 112, in place of designating the area by the pointing device or the like, the area can be also designated by vertically or horizontally moving a cursor by a key on a keyboard.

On the other hand, a fact that two areas were selected has been indicated by displaying the line segment connecting the designated points in both areas. In place of such a method, however, the area frames of two areas can be also displayed by changing the display color.

Further, the area data structure can include not only the data shown as an example in Fig. 44 but also the data such as the number of pixels in the area, writing direction of the sentence, and the like.

In the attribute corrector 113, in place of continuously designating the area twice by using the pointing device or the like, it is also possible to construct in a manner such that an attribute changing mode switch is provided and is turned on or off, thereby changing the meaning of the instruction of the pointing device or the like (specifically speaking, the ON-state of the attribute changing mode switch indicates the area instruction to change the attributes of the area, and the OFF-state indicates the area instruction to correct the division of the area).

With respect to the display of the current attributes in the list table of the attributes, they can be also displayed by changing the display color in place of reversing and displaying.

Further, in place of displaying the relevant area frame by changing from the solid line to the dotted line, it can be also displayed by changing the frame color.

In place of the list table of the attributes, it is also possible to construct in a manner such that only the current attributes are displayed and the display of the attribute display portion is changed by an instruction by using the pointing device or the like or by providing and operating a display changing switch, and by repeating such an operation until desired attributes are displayed, the attributes can be changed.

Claims

1. An image processing apparatus comprising:
image input means for inputting an image;
image thinning means for getting the OR between (m dots in the vertical direction) x (n dots in the horizontal direction) for the input image from said image input means, thereby thinning out (m x n) pixels and newly forming one pixel;
labeling means for adding a label every line to black pixels of the image which was thinned out by said image thinning means and adding the same label to the pixels which are continuous in the vertical, horizontal, or oblique direction and simultaneously tracing a rectangle; and
separator detecting means for distinguishing a rectangle corresponding to a sentence portion, a rectangle corresponding to a figure or photograph, a rectangle corresponding to a table, a rectangle corresponding to a separator, and the like by using a width, a height, and an area of said rectangle added with the label by said labeling means and by using the number of pixels for said area, namely, a pixel density,
wherein an area of the input image is divided on the basis of the result of the detection of said separator detecting means.

2. An apparatus according to claim 1, further comprising:
writing direction detecting means for presuming a vertical writing sentence or a horizontal writing sentence by comparing the width and height of the rectangle corresponding to the sentence portion distinguished by said separator detecting means;
index detecting means for detecting an index by using the writing direction judged by said writing direction detecting means and a character size; and
rectangle combining means for combining the rectangles by using an imaginary rectangle obtained by enlarging the size of inherent rectangle.

3. An image processing method comprising the steps of:
inputting image information;
recognizing a rectangle by detecting continuous pixels for black pixels of said image information;
discriminating attributes of said rectangle by using a width, a height, an area, and a pixel density of an area indicated by said recognized rectangle; and
calculating and comparing partial histograms of said recognized area, thereby determining the attributes of said area.

4. An image processing method comprising the steps of:
inputting image information;
recognizing a rectangle by detecting continuous pixels for black pixels of said image information;
discriminating attributes of said rectangle by using a width, a height, an area, and a pixel density of an area indicated by said recognized rectangle;
detecting rules of the recognized area; and
determining attributes of said area by the number of rules.

5. An image processing method comprising the steps of:
inputting image information;
recognizing a rectangle by detecting continuous pixels for black pixels of said image information;
discriminating attributes of said rectangle by using a width, a height, an area, and a pixel density of an area indicated by said recognized rectangle; and
determining attributes of said area from a ratio between the area of the area which was judged to be a table area and an area in a table frame.

6. A method according to claim 3, 4, or 5, wherein said attributes indicate either a body or a figure or a table.

7. An image processing apparatus comprising:
input means for inputting image information;
rectangle recognizing means for recognizing a rectangle by detecting continuous pixels for black pixels of said image information;
attribute discriminating means for discriminating attributes of said rectangle by using a width, a height, an area, and a pixel density of an area indicated by said recognized rectangle; and
control means for controlling so as to determine attributes of said recognized area by calculating and comparing partial histograms of said area.

8. An image processing apparatus comprising:
input means for inputting image information;
rectangle recognizing means for recognizing a rectangle by detecting continuous pixels for black pixels of said image information;
attribute discriminating means for discrim-

inating attributes of said recognized rectangle by using a width, a height, an area, and a pixel density of an area indicated by said rectangle;

rule detecting means for detecting rules in said recognized area; and

control means for controlling so as to determine attributes of said area by the number of said rules.

9. An image processing apparatus comprising:

input means for inputting image information;

rectangle recognizing means for recognizing a rectangle by detecting continuous pixels for black pixels of said image information;

attribute discriminating means for discriminating attributes of said recognized rectangle by using a width, a height, an area, and a pixel density of an area indicated by said rectangle; and

control means for controlling so as to determine attributes of said area from a ratio of an area of the area which was judged to be a table area and an area in a table frame.

10. An apparatus according to claim 7, 8 or 9, wherein said attributes indicate either a body or a figure or a table.

11. An image processing method comprising the steps of:

inputting image information;

area-dividing said inputted image information every attribute;

storing area information which was area-divided and attribute information;

instructing to correct said attribute information stored; and

updating the stored attribute information in accordance with said instruction.

12. An image processing apparatus comprising:

input means for inputting image information;

area-dividing means for area-dividing said inputted image information every attribute;

storing means for storing area information which was area-divided and attribute information;

correction instructing means for instructing to correct said stored attribute information; and

updating control means for updating the stored attribute information in accordance with said instruction.

13. An image processing apparatus comprising:

area designating means for designating special divisional areas to be coupled among a plurality of divisional areas included in an input image; and

correcting means for integratedly coupling the divisional areas designated by said area designating means and correcting the original divisional areas.

14. An apparatus according to claim 13, further having means for correcting attributes of the designated areas in association with the division of said areas.

15. Image processing apparatus or method in which an input image is analysed to detect specific image configurations, and the image is divided in accordance with the detected configurations into labelled rectangle data.

FIG. 1

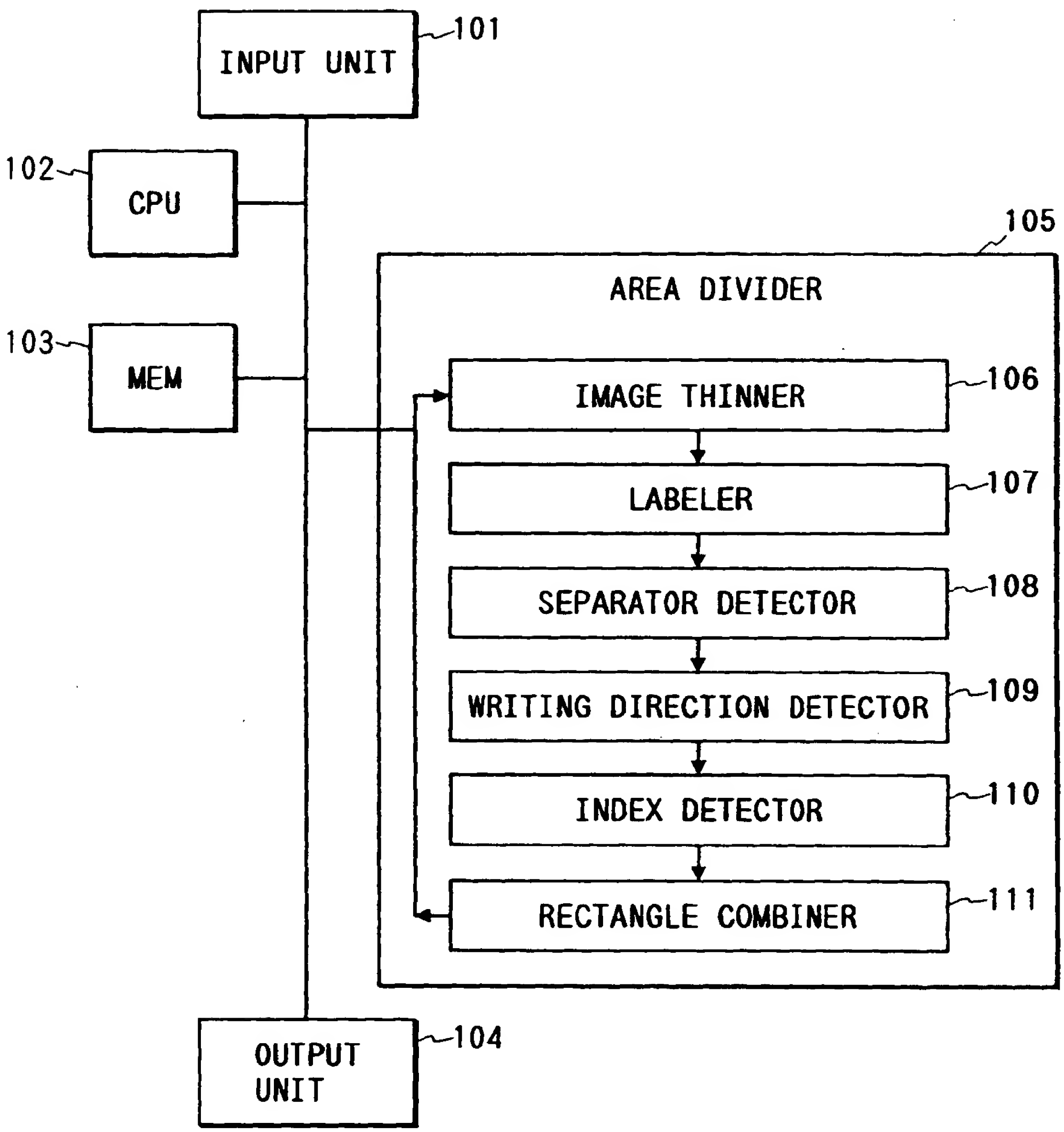

INPUT UNIT
101
CPU
102
MEM
103
AREA DIVIDER
105
IMAGE THINNER
106
LABELER
107
SEPARATOR DETECTOR
108
WRITING DIRECTION DETECTOR
109
INDEX DETECTOR
110
RECTANGLE COMBINER
111
OUTPUT UNIT
104

FIG. 2

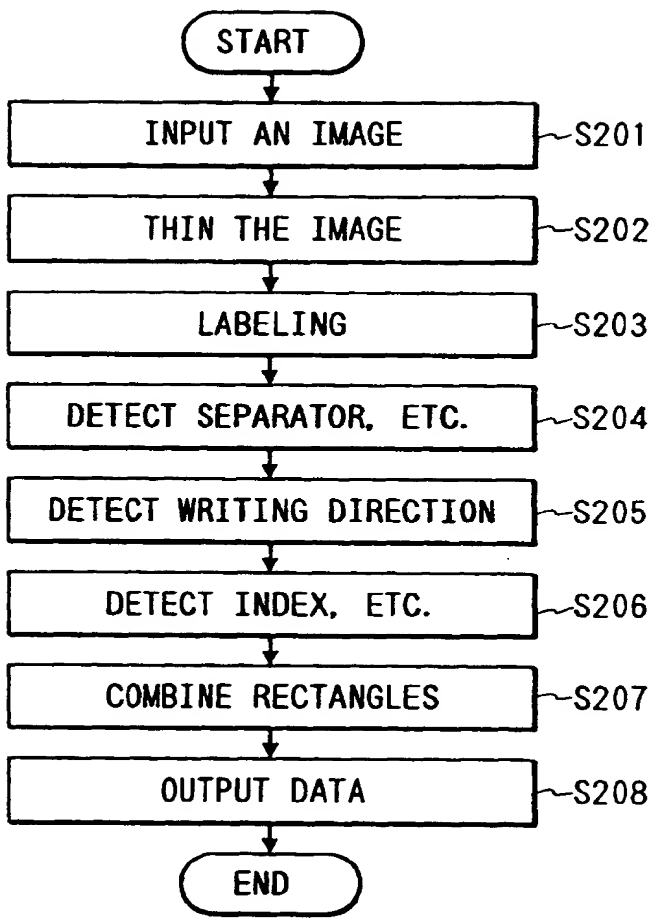

START
INPUT AN IMAGE
S201
THIN THE IMAGE
S202
LABELING
S203
DETECT SEPARATOR, ETC.
S204
DETECT WRITING DIRECTION
S205
DETECT INDEX, ETC.
S206
COMBINE RECTANGLES
S207
OUTPUT DATA
S208
END

FIG. 3

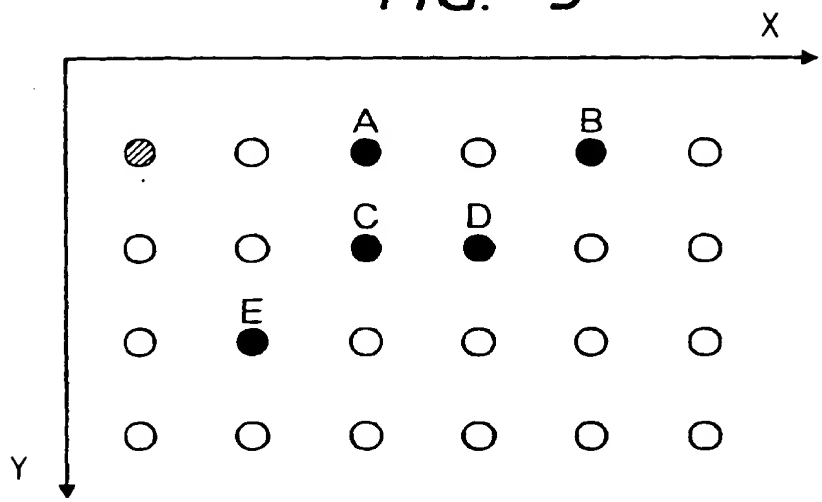


FIG. 4

RECTANGLE DATA
RECTANGLE LABEL
INITIAL POINT COORDINATE
TERMINAL POINT COORDINATE
PIXEL LABEL
THE NO. OF PIXELS

FIG. 5A

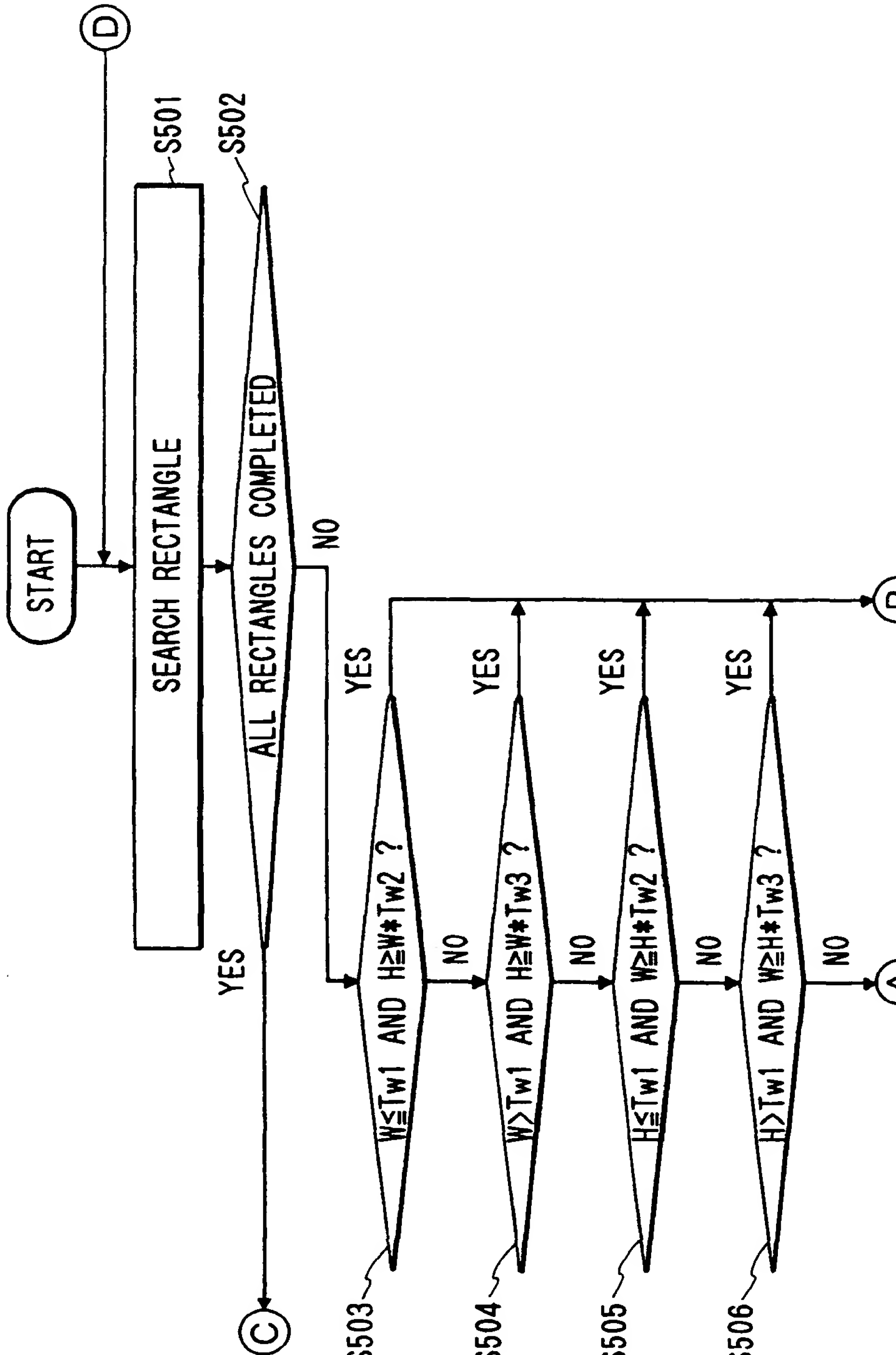

START
D
SEARCH RECTANGLE
S501
ALL RECTANGLES COMPLETED
S502
YES
NO
C
W≦Tw1 AND H≧W*Tw2 ?
S503
W>Tw1 AND H≧W*Tw3 ?
S504
H≦Tw1 AND W≧H*Tw2 ?
S505
H>Tw1 AND W≧H*Tw3 ?
S506
YES
YES
YES
YES
NO
NO
NO
NO
B
A

FIG. 5

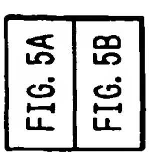


FIG. 5A
FIG. 5B

FIG. 5B

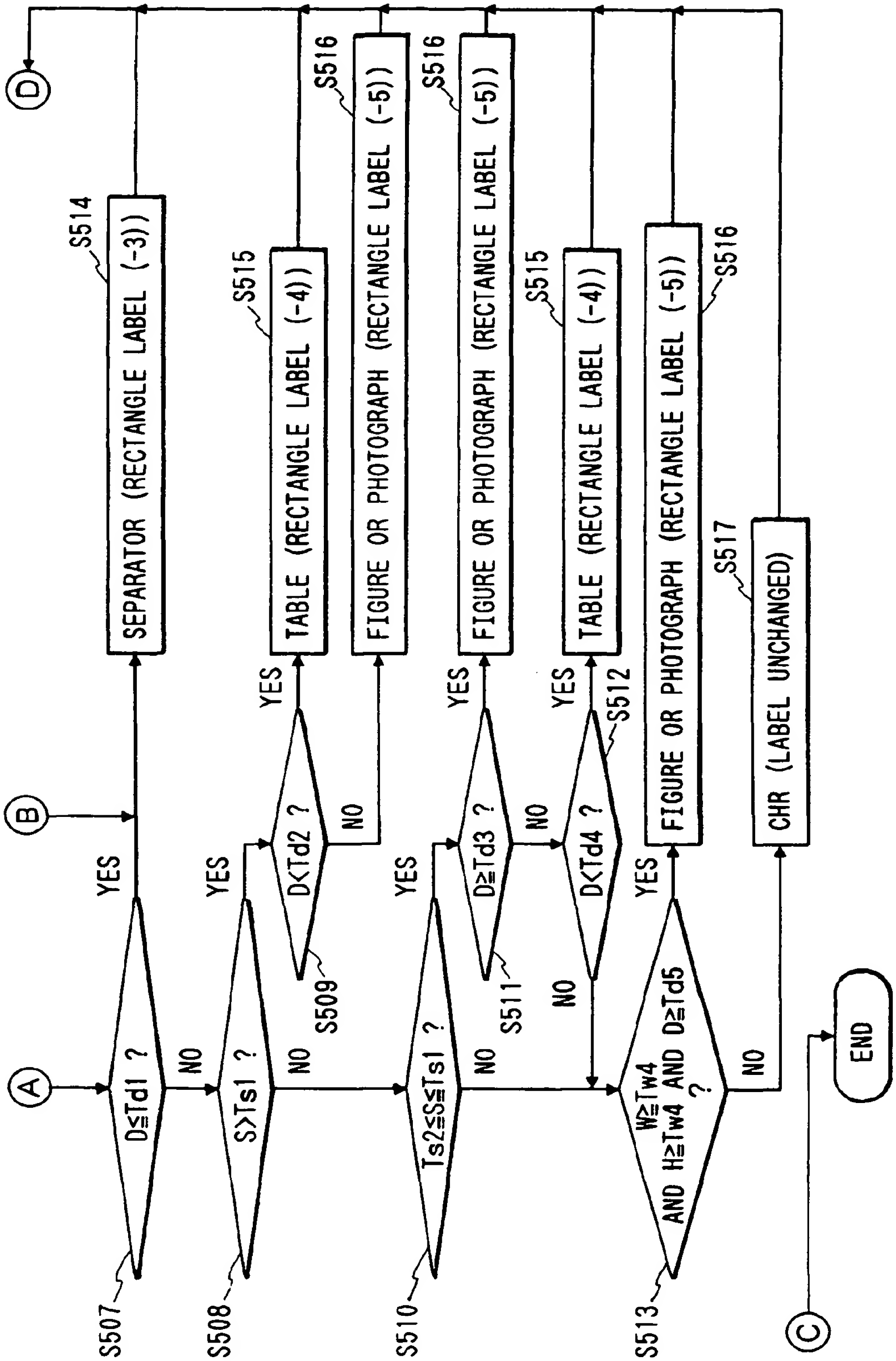
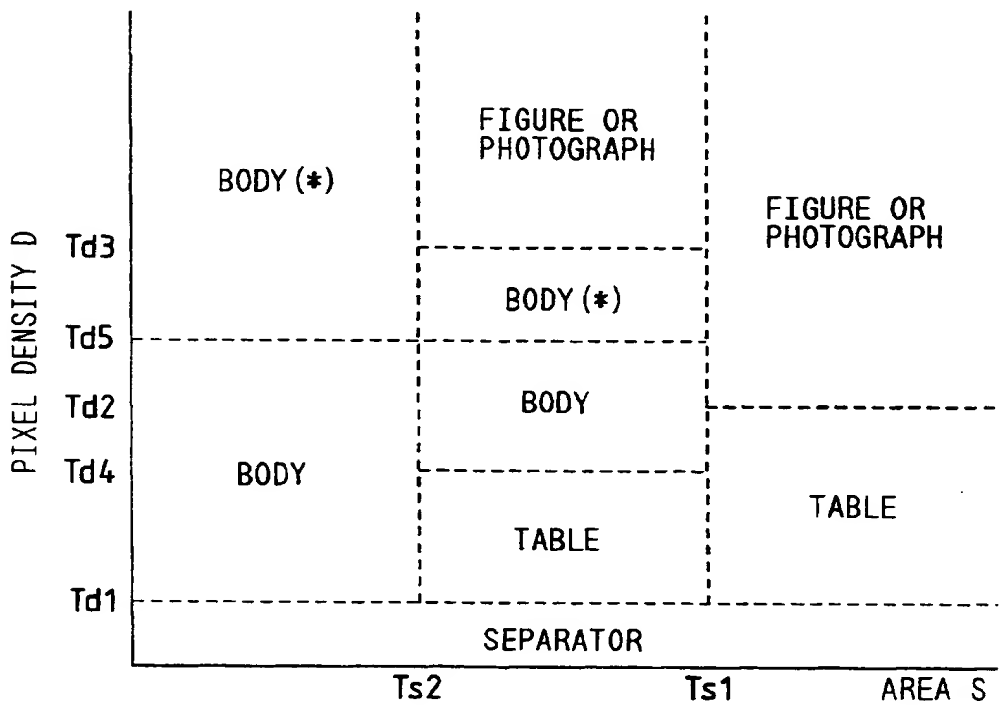

A
B
C
D
S507
D≦Td1 ?
YES
NO
S508
S>Ts1 ?
S509
D<Td2 ?
S510
Ts2≦S≦Ts1 ?
S511
D≧Td3 ?
S512
D<Td4 ?
S513
W≧Tw4 AND H≧Tw4 AND D≧Td5 ?
S514
SEPARATOR (RECTANGLE LABEL (-3))
S515
TABLE (RECTANGLE LABEL (-4))
S516
FIGURE OR PHOTOGRAPH (RECTANGLE LABEL (-5))
S517
CHR (LABEL UNCHANGED)
END

FIG. 6



* FIGURE OR PHOTOGRAPH, IF W ≧ Tw4 AND H ≧ Tw4 AND D ≧ Td5

FIG. 7

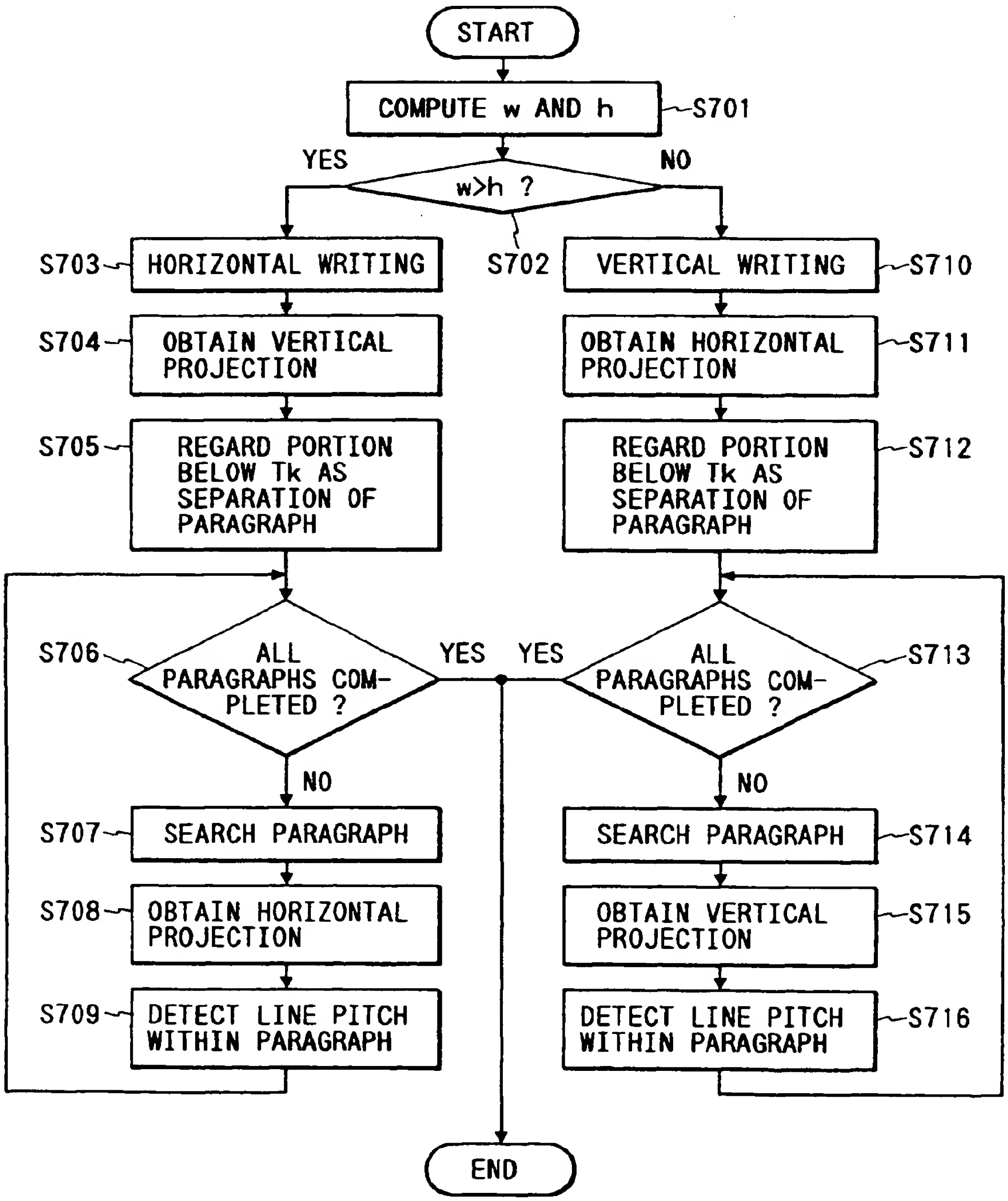

START
COMPUTE w AND h
S701
YES
NO
w>h ?
S702
S703
HORIZONTAL WRITING
VERTICAL WRITING
S710
S704
OBTAIN VERTICAL PROJECTION
OBTAIN HORIZONTAL PROJECTION
S711
S705
REGARD PORTION BELOW Tk AS SEPARATION OF PARAGRAPH
REGARD PORTION BELOW Tk AS SEPARATION OF PARAGRAPH
S712
S706
ALL PARAGRAPHS COM-PLETED ?
YES
YES
ALL PARAGRAPHS COM-PLETED ?
S713
NO
NO
S707
SEARCH PARAGRAPH
SEARCH PARAGRAPH
S714
S708
OBTAIN HORIZONTAL PROJECTION
OBTAIN VERTICAL PROJECTION
S715
S709
DETECT LINE PITCH WITHIN PARAGRAPH
DETECT LINE PITCH WITHIN PARAGRAPH
S716
END

FIG. 8

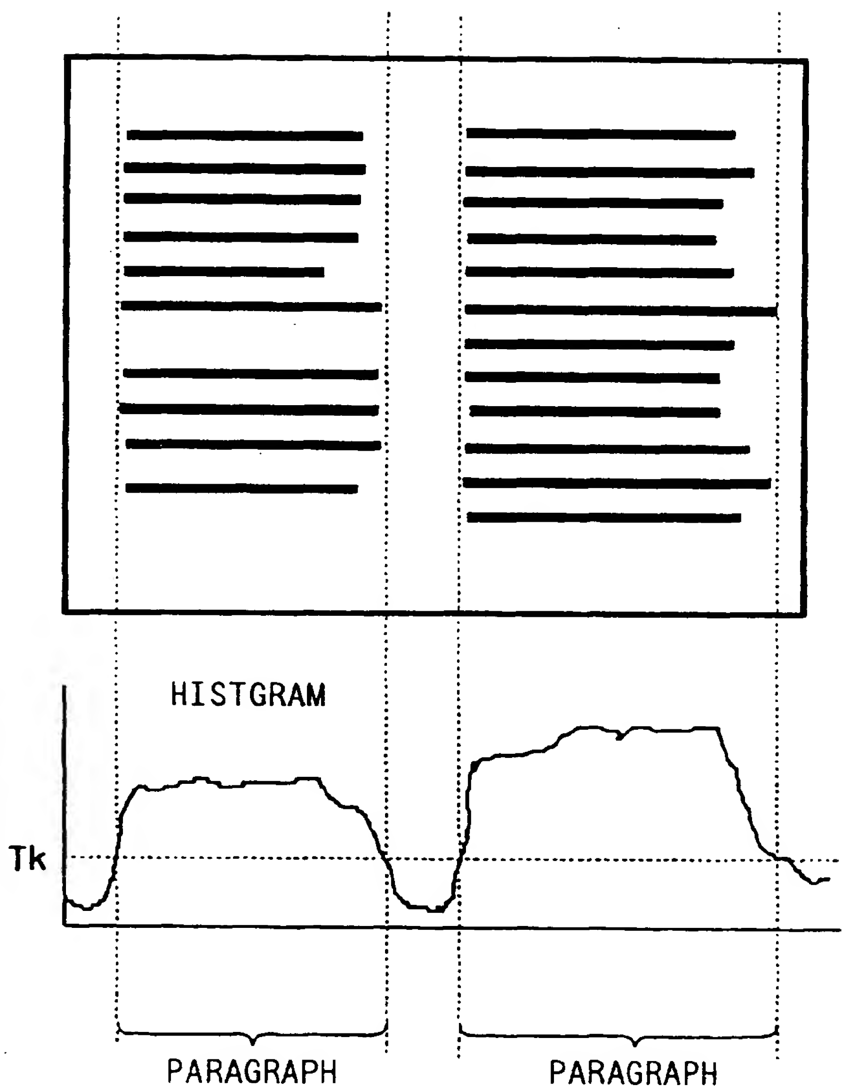


FIG. 9

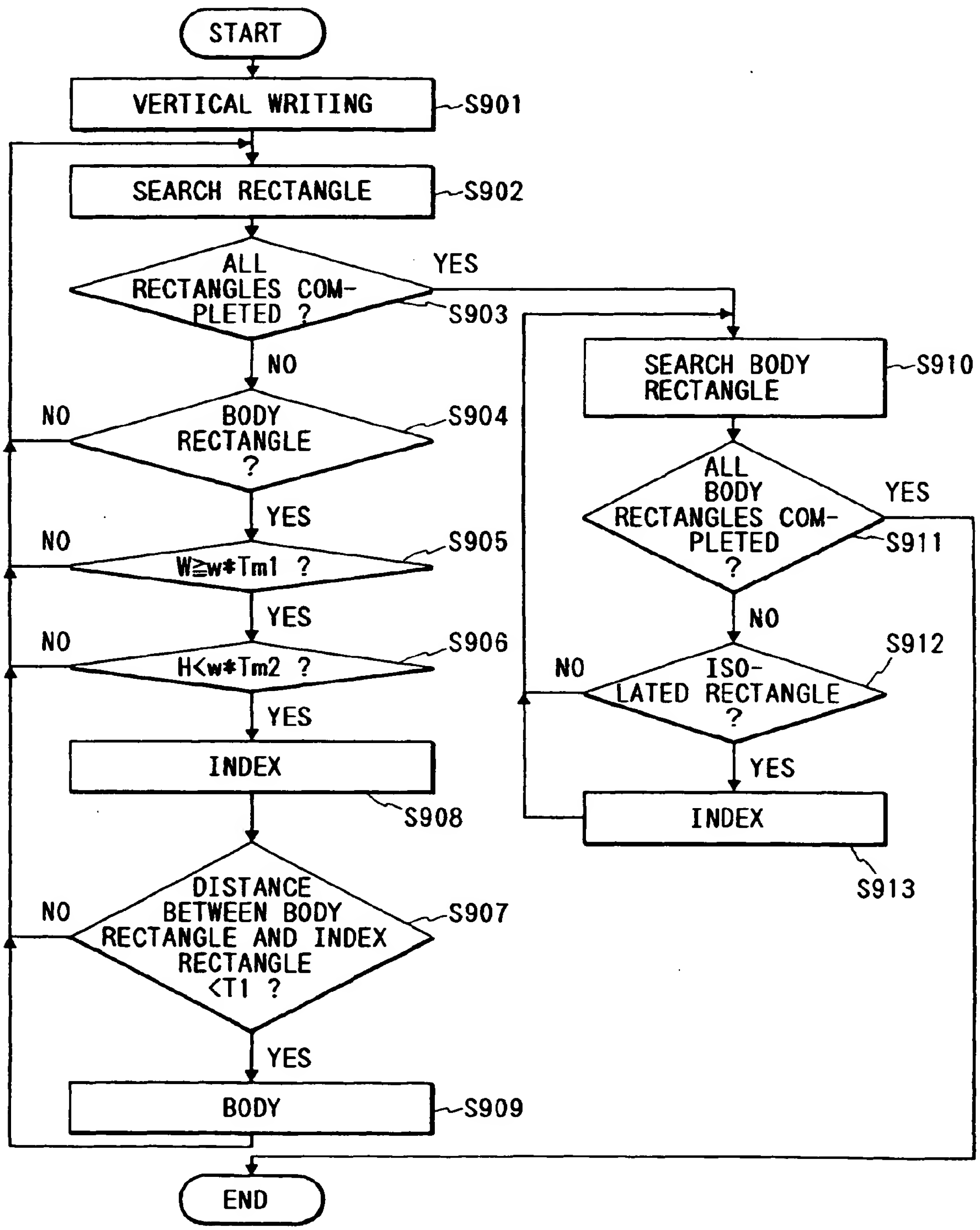

START
VERTICAL WRITING
S901
SEARCH RECTANGLE
S902
ALL RECTANGLES COM-PLETED ?
YES
S903
NO
BODY RECTANGLE ?
S904
NO
YES
W≧w*Tm1 ?
S905
NO
YES
H<w*Tm2 ?
S906
NO
YES
INDEX
S908
DISTANCE BETWEEN BODY RECTANGLE AND INDEX RECTANGLE <T1 ?
S907
NO
YES
BODY
S909
SEARCH BODY RECTANGLE
S910
ALL BODY RECTANGLES COM-PLETED ?
YES
S911
NO
ISO-LATED RECTANGLE ?
S912
NO
YES
INDEX
S913
END

FIG. 10

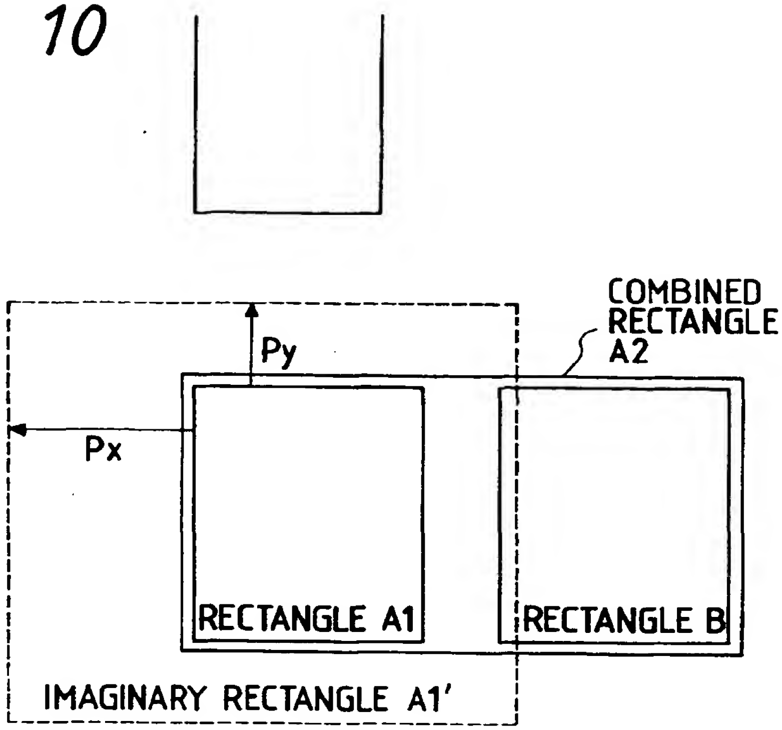

COMBINED RECTANGLE A2
Py
Px
RECTANGLE A1
RECTANGLE B
IMAGINARY RECTANGLE A1'

FIG. 11

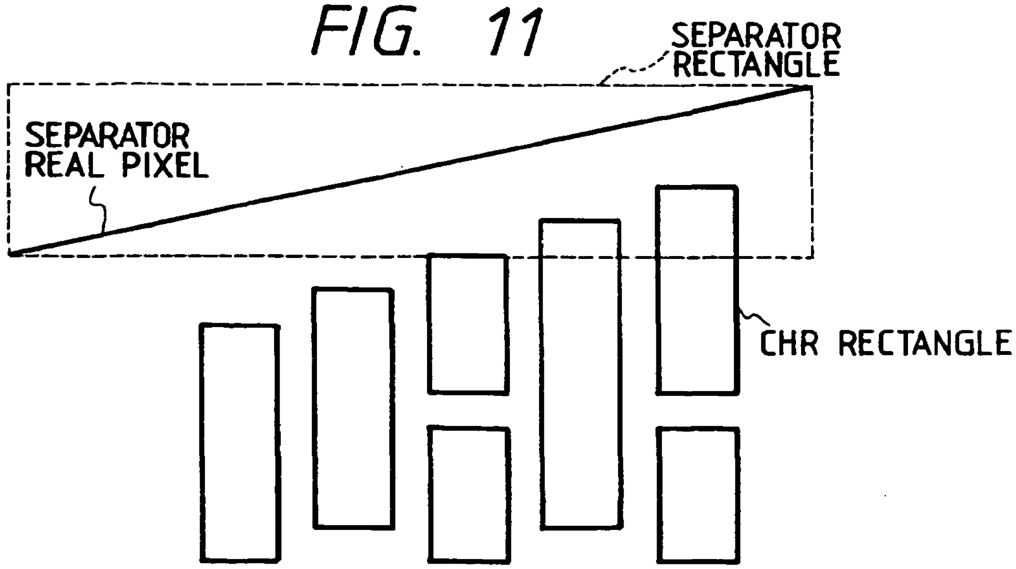

SEPARATOR RECTANGLE
SEPARATOR REAL PIXEL
CHR RECTANGLE

FIG. 12

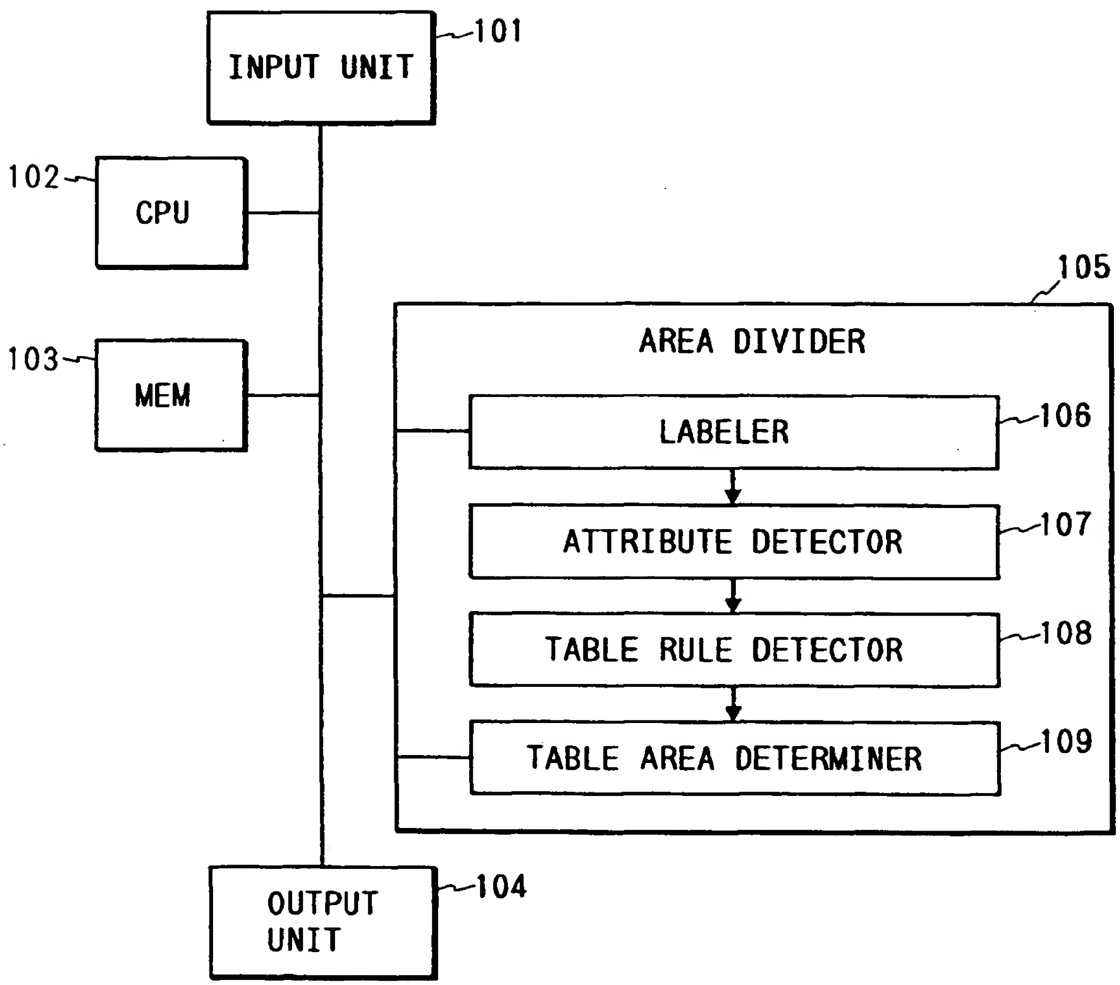

INPUT UNIT
101
102
CPU
103
MEM
105
AREA DIVIDER
LABELER
106
ATTRIBUTE DETECTOR
107
TABLE RULE DETECTOR
108
TABLE AREA DETERMINER
109
OUTPUT UNIT
104

FIG. 13

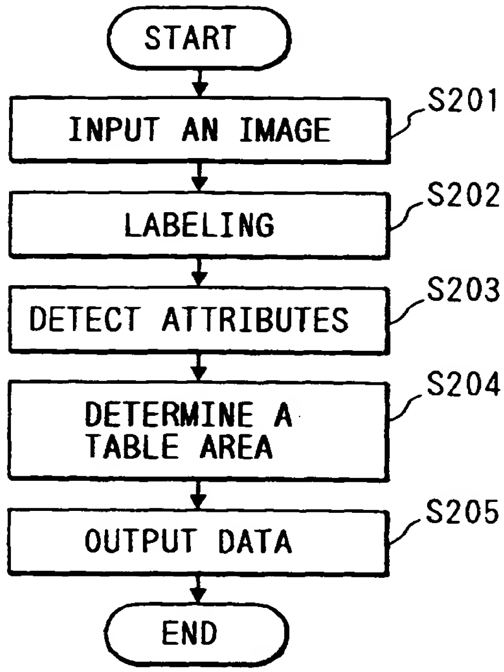

START
INPUT AN IMAGE
S201
LABELING
S202
DETECT ATTRIBUTES
S203
DETERMINE A TABLE AREA
S204
OUTPUT DATA
S205
END

FIG. 14

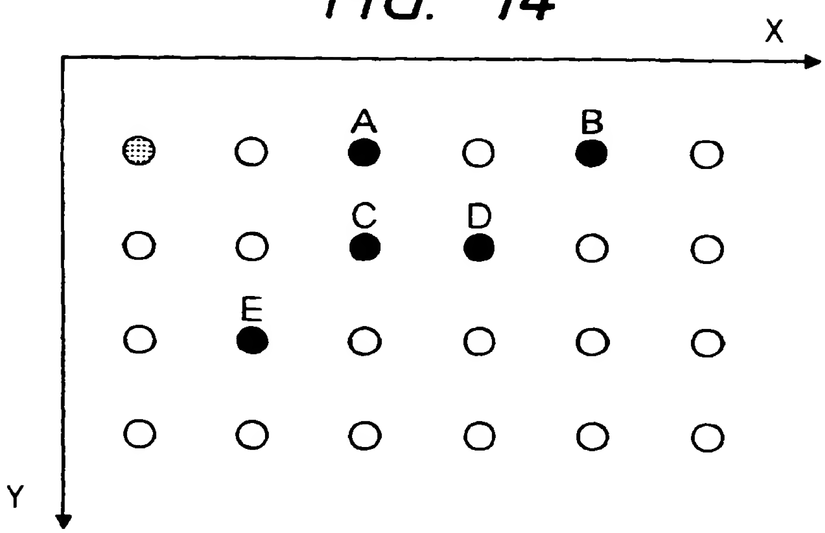

X
Y
A
B
C
D
E

FIG. 15

RECTANGLE DATA
RECTANGLE LABEL
INITIAL POINT COORDINATE
TERMINAL POINT COORDINATE
PIXEL LABEL
THE NO. OF PIXELS

RECTANGLE LABEL	ATTRIBUTE
POSITIVE INTEGER	BODY
0	INVALID
-1	NOT USED
-2	NOT USED
-3	SEPARATOR
-4	TABLE
-5	FIGURE, PHOTOGRAPH

FIG. 16

FIG. 16A

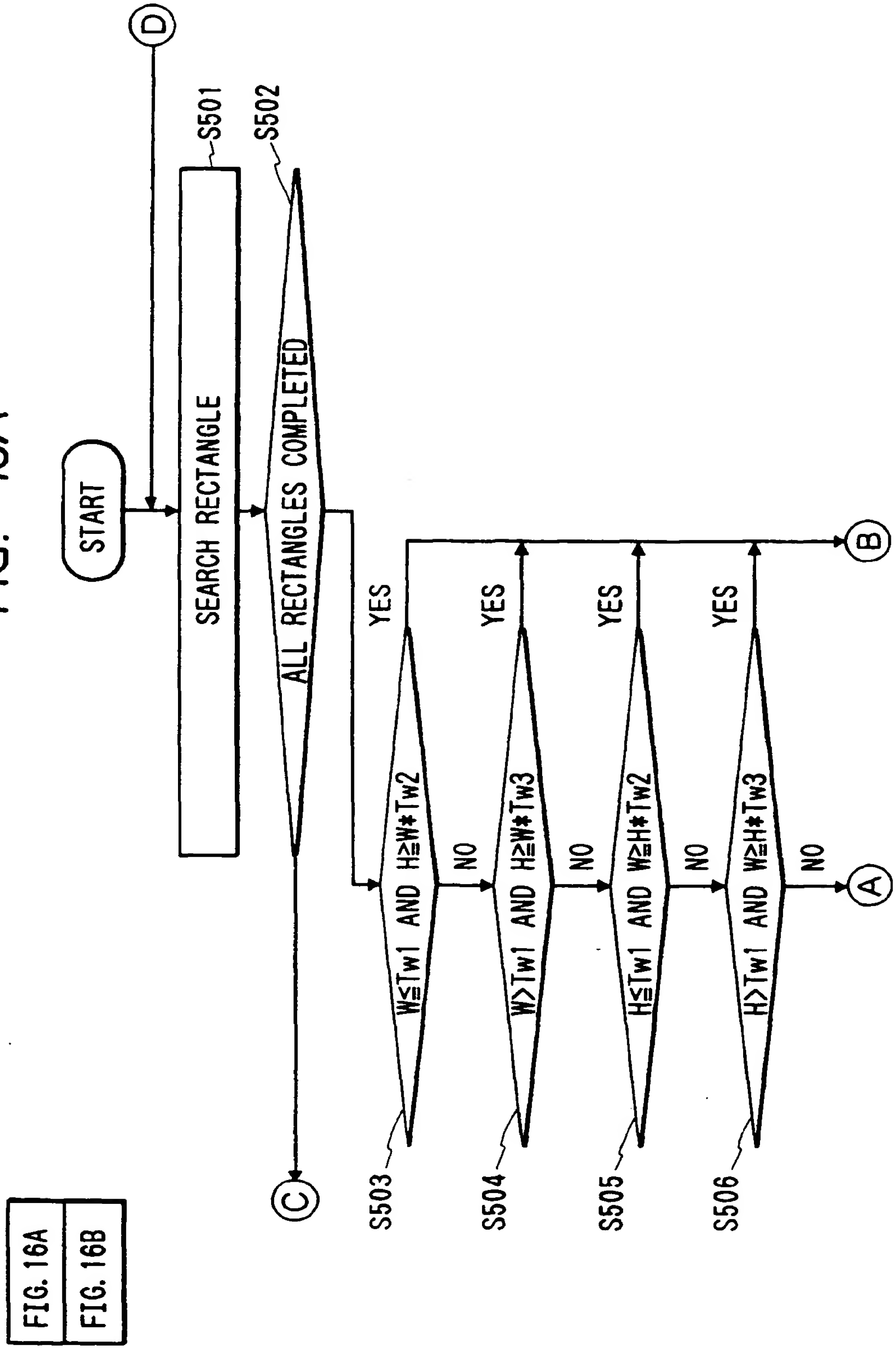
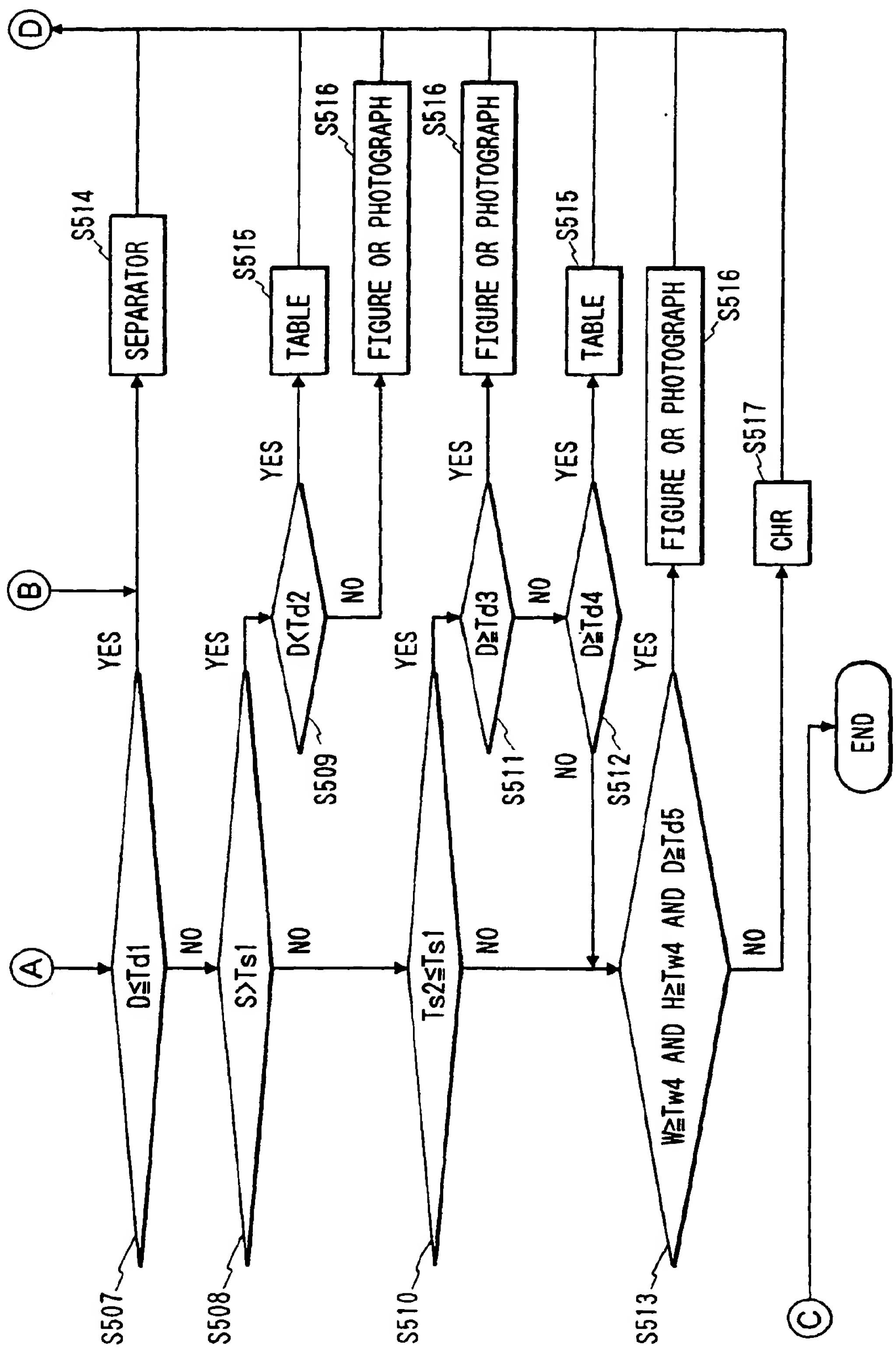
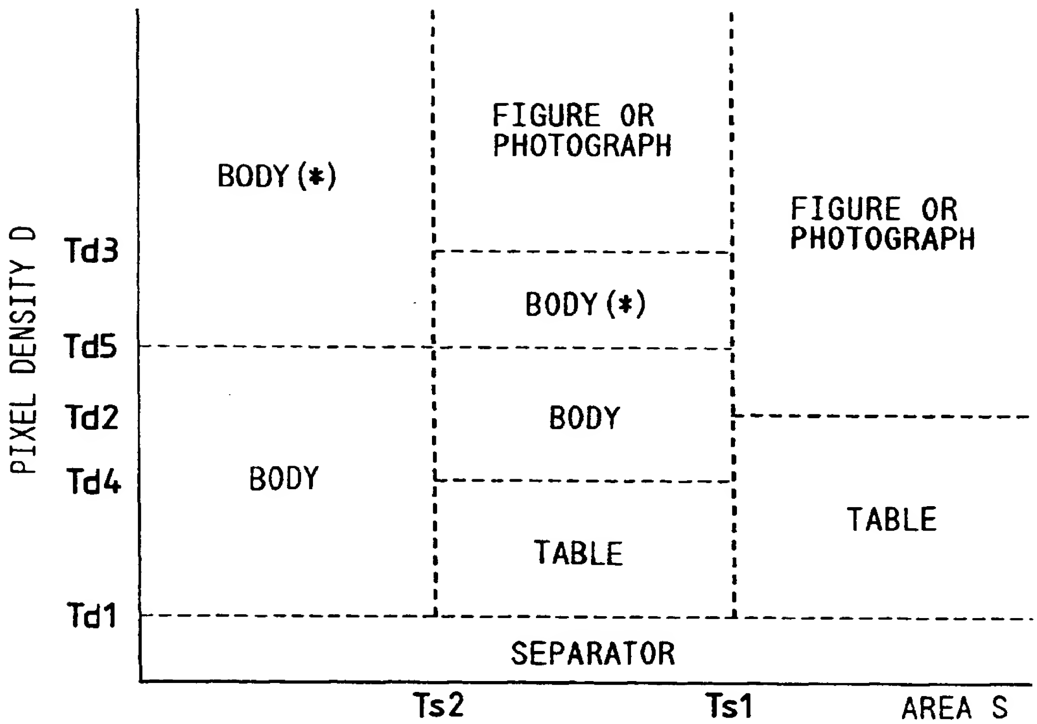


FIG. 16B



A
B
C
D
S507
D≦Td1
YES
NO
S508
S>Ts1
YES
NO
S509
D<Td2
YES
NO
S510
Ts2≦Ts1
YES
NO
S511
D≧Td3
YES
NO
S512
D≧Td4
YES
NO
S513
W≧Tw4 AND H≧Tw4 AND D≧Td5
YES
NO
S514
SEPARATOR
S515
TABLE
S516
FIGURE OR PHOTOGRAPH
S517
CHR
END

FIG. 17



* FIGURE OR PHOTOGRAPH, IF W ≧ Tw4 AND H ≧ Tw4 AND D ≧ Td5

FIG. 18

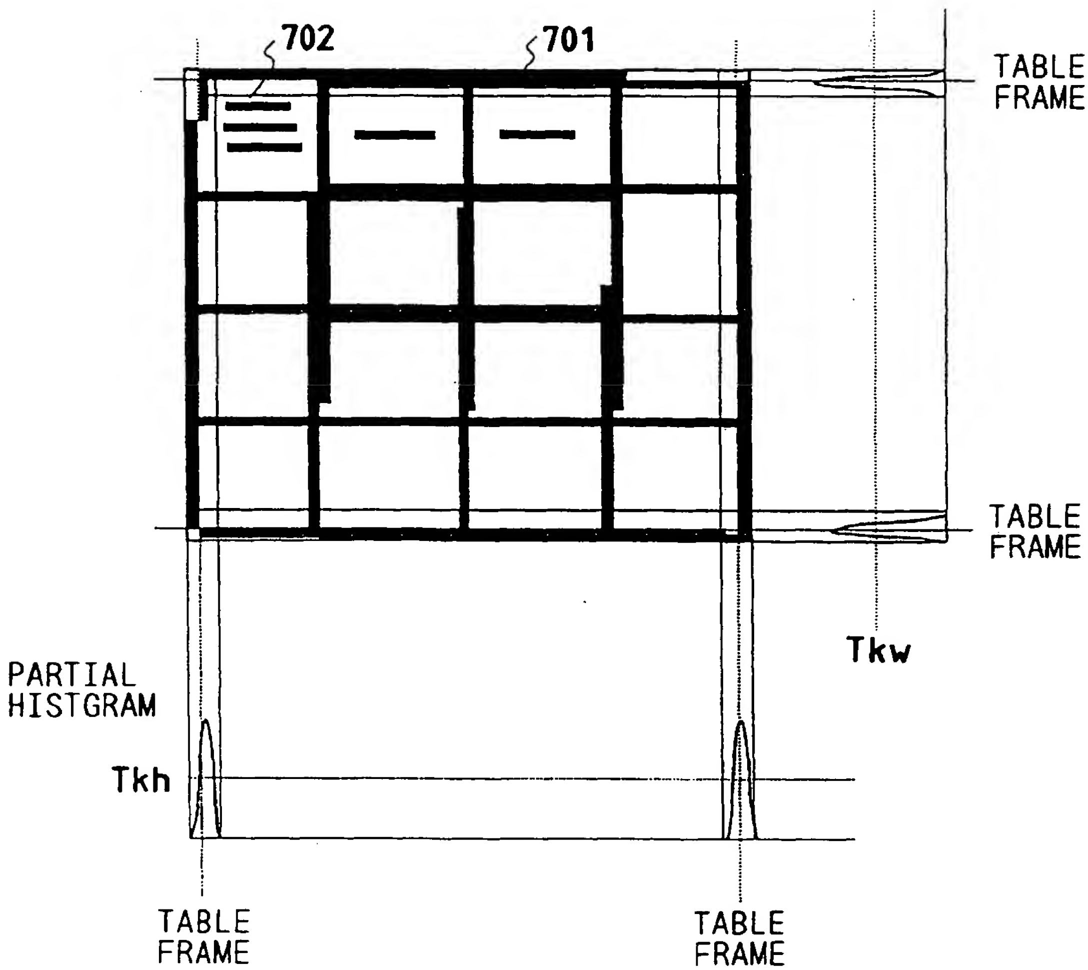

702
701
TABLE FRAME
TABLE FRAME
Tkw
PARTIAL HISTGRAM
Tkh
TABLE FRAME
TABLE FRAME

FIG. 19

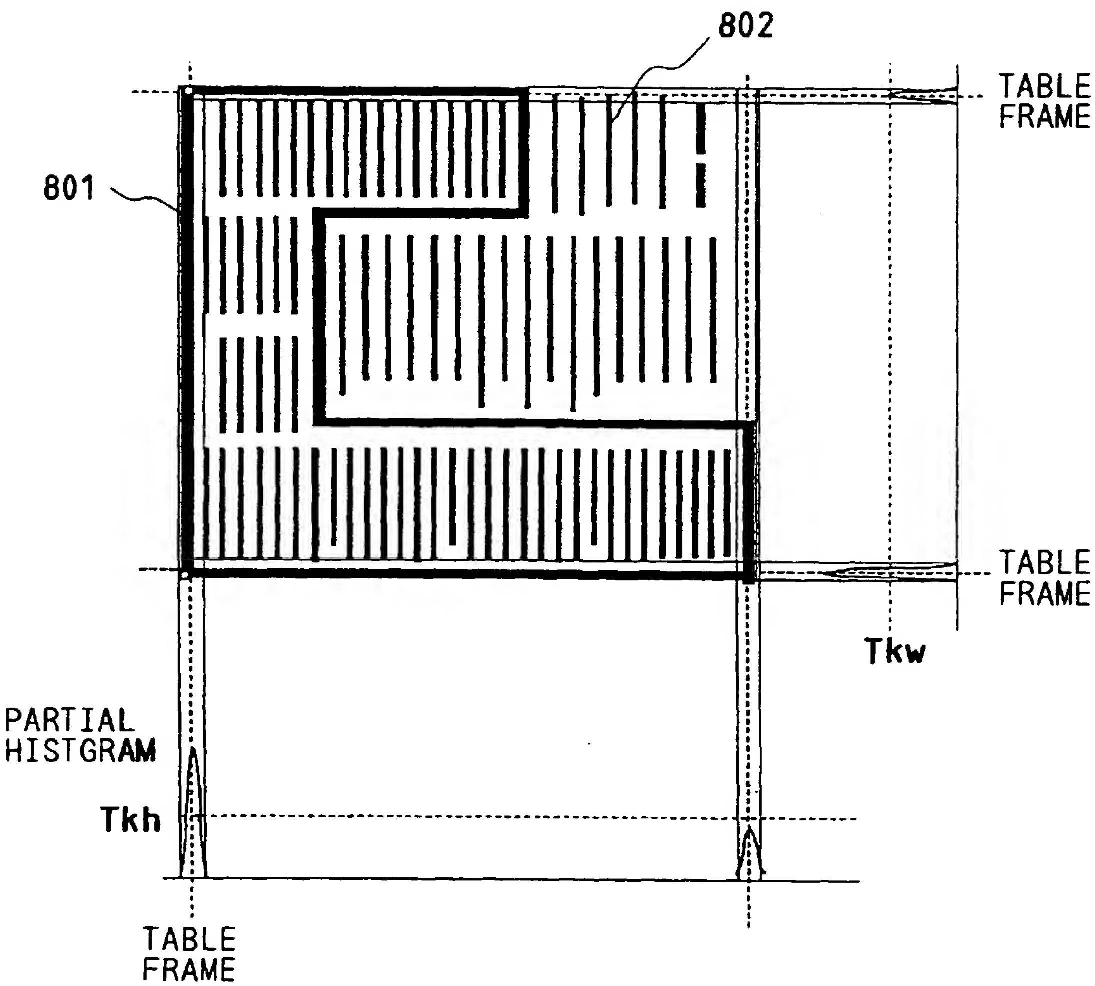

802
801
TABLE
FRAME
TABLE
FRAME
Tkw
PARTIAL
HISTGRAM
Tkh
TABLE
FRAME

FIG. 20

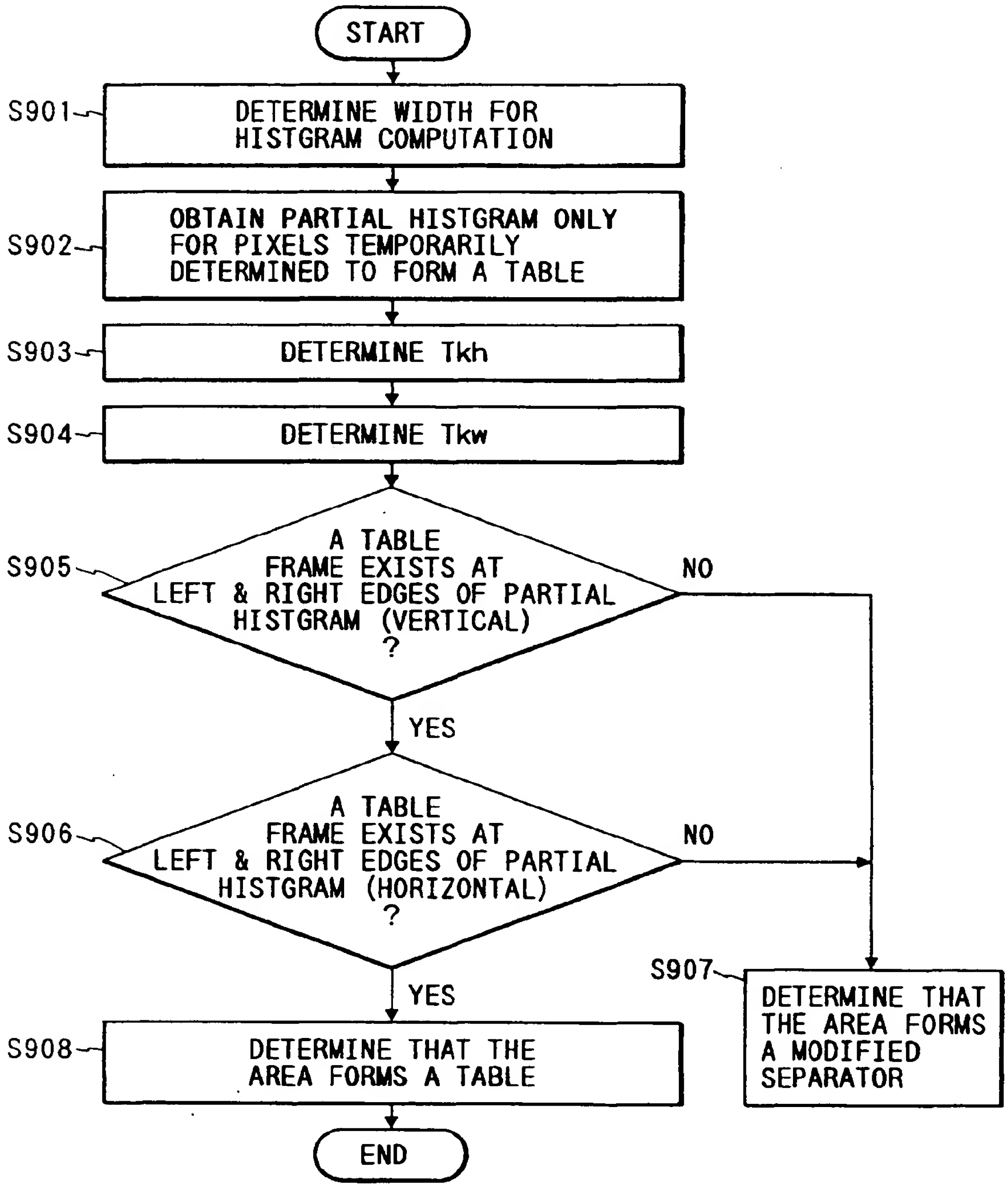

START
S901
DETERMINE WIDTH FOR HISTGRAM COMPUTATION
S902
OBTAIN PARTIAL HISTGRAM ONLY FOR PIXELS TEMPORARILY DETERMINED TO FORM A TABLE
S903
DETERMINE Tkh
S904
DETERMINE Tkw
S905
A TABLE FRAME EXISTS AT LEFT & RIGHT EDGES OF PARTIAL HISTGRAM (VERTICAL) ?
NO
YES
S906
A TABLE FRAME EXISTS AT LEFT & RIGHT EDGES OF PARTIAL HISTGRAM (HORIZONTAL) ?
NO
YES
S907
DETERMINE THAT THE AREA FORMS A MODIFIED SEPARATOR
S908
DETERMINE THAT THE AREA FORMS A TABLE
END

FIG. 21

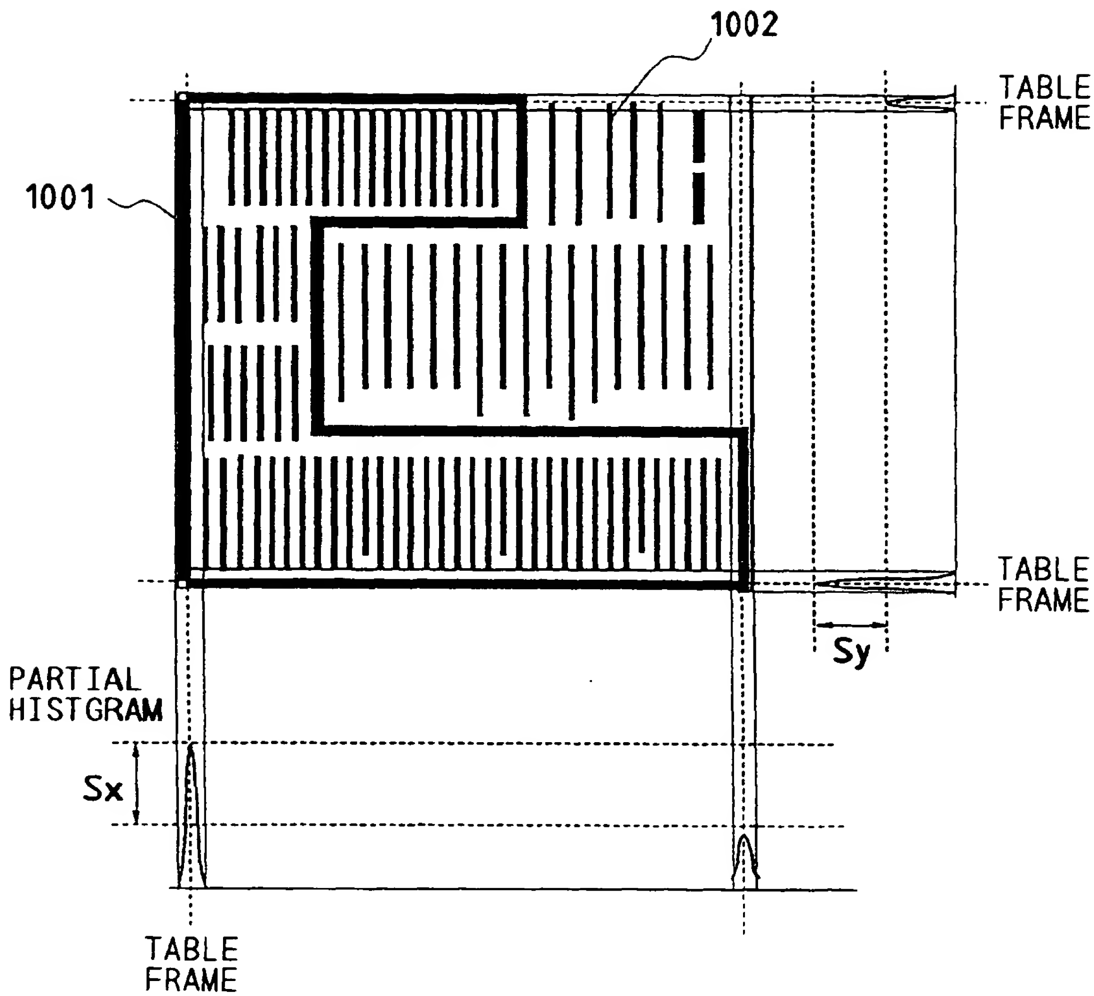

1002
TABLE FRAME
1001
TABLE FRAME
Sy
PARTIAL HISTGRAM
Sx
TABLE FRAME

FIG. 22

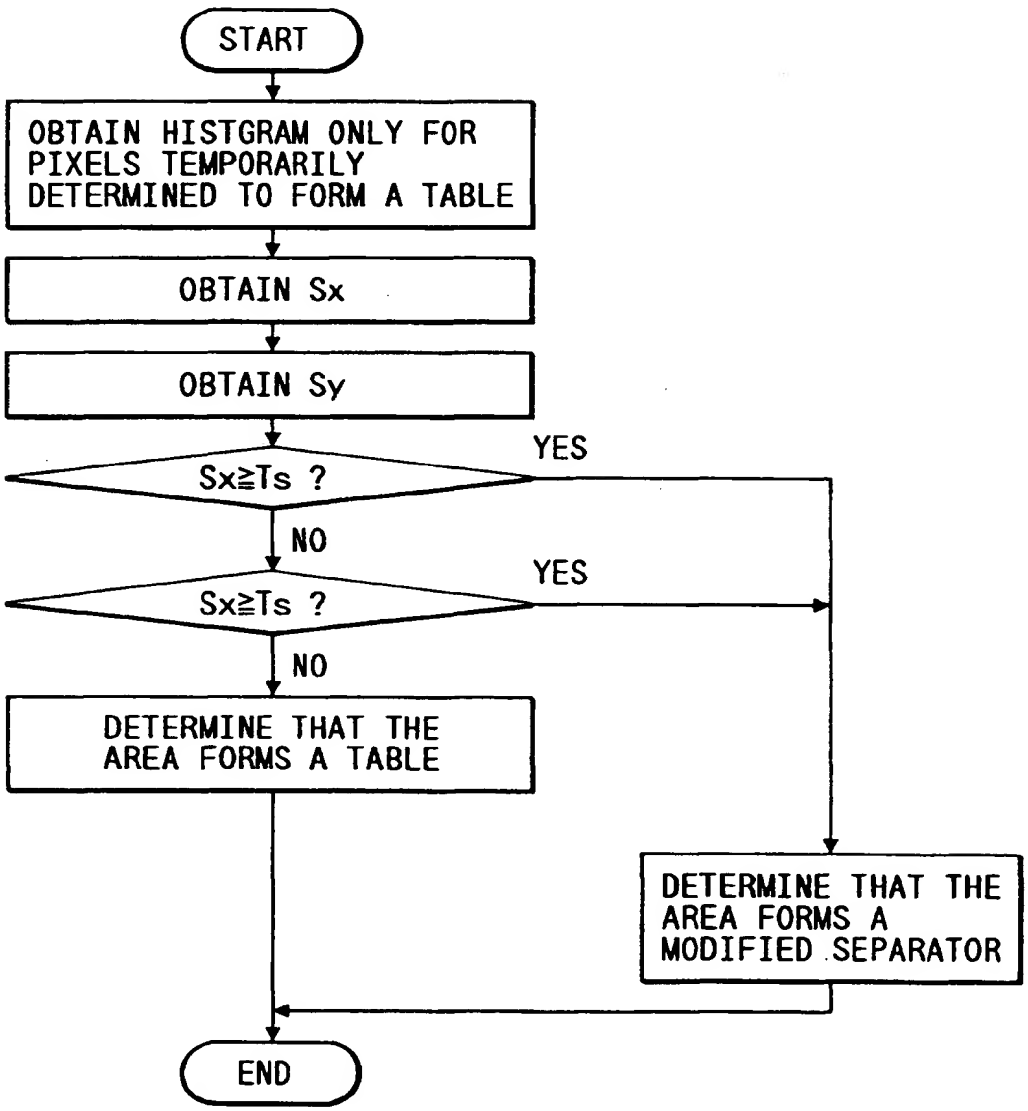

START
OBTAIN HISTGRAM ONLY FOR PIXELS TEMPORARILY DETERMINED TO FORM A TABLE
OBTAIN Sx
OBTAIN Sy
Sx≧Ts ?
YES
NO
Sx≧Ts ?
YES
NO
DETERMINE THAT THE AREA FORMS A TABLE
DETERMINE THAT THE AREA FORMS A MODIFIED SEPARATOR
END

FIG. 23

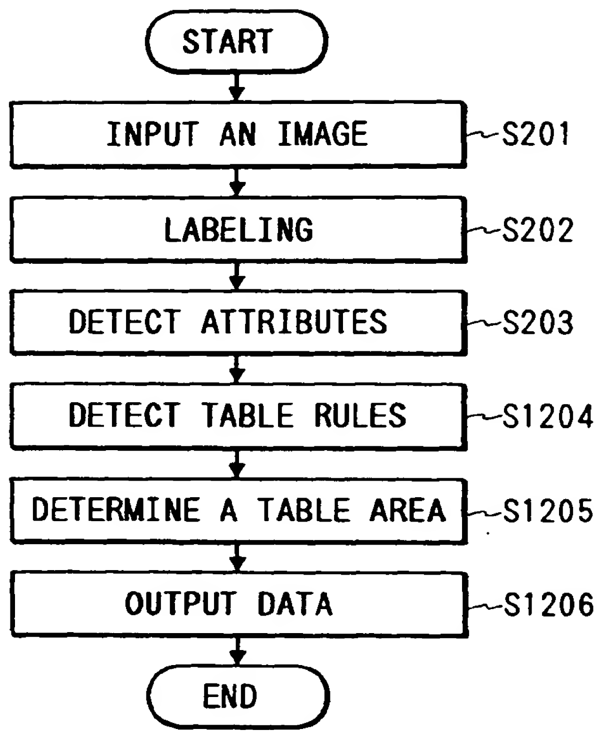

START
INPUT AN IMAGE
S201
LABELING
S202
DETECT ATTRIBUTES
S203
DETECT TABLE RULES
S1204
DETERMINE A TABLE AREA
S1205
OUTPUT DATA
S1206
END

FIG. 24

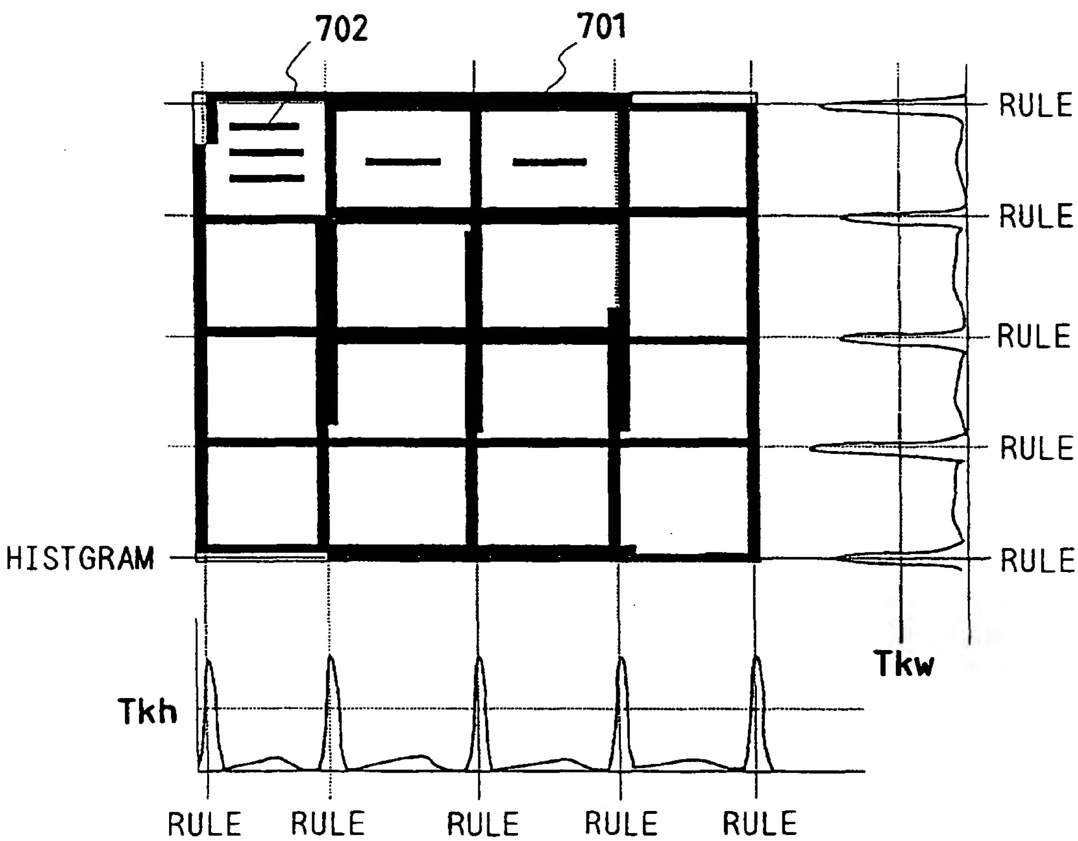

702
701
RULE
RULE
RULE
RULE
RULE
HISTGRAM
Tkw
Tkh
RULE
RULE
RULE
RULE
RULE

FIG. 25

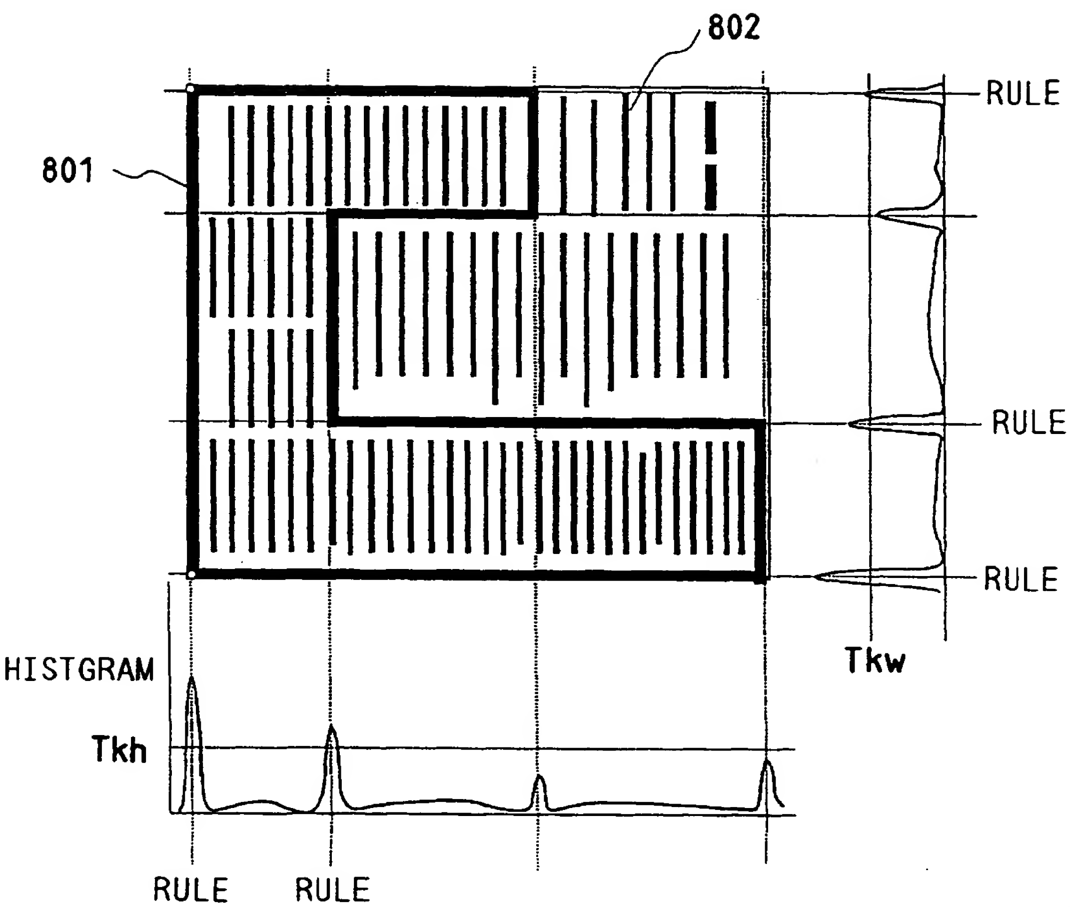


FIG. 26

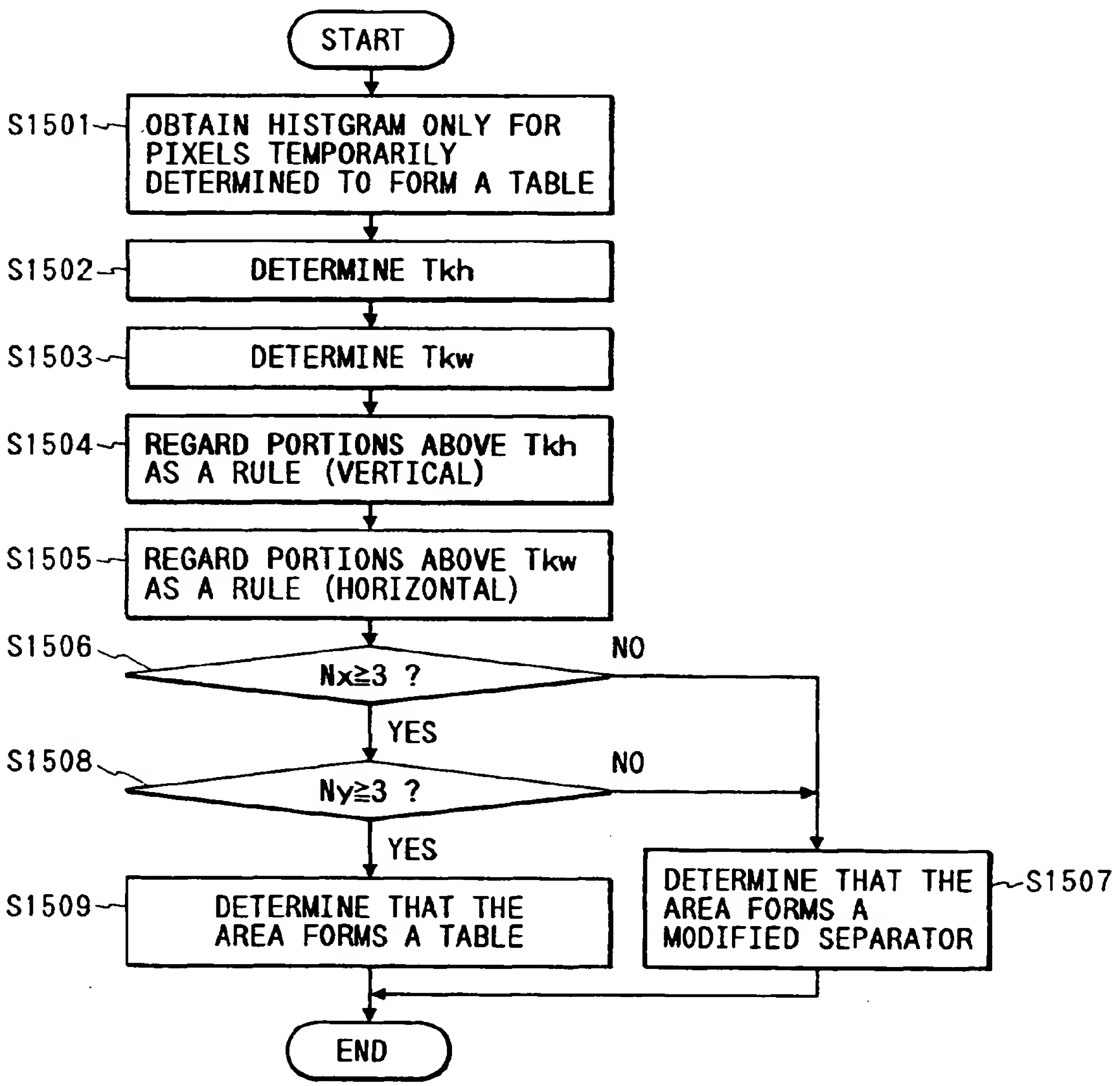

START
S1501
OBTAIN HISTGRAM ONLY FOR PIXELS TEMPORARILY DETERMINED TO FORM A TABLE
S1502
DETERMINE Tkh
S1503
DETERMINE Tkw
S1504
REGARD PORTIONS ABOVE Tkh AS A RULE (VERTICAL)
S1505
REGARD PORTIONS ABOVE Tkw AS A RULE (HORIZONTAL)
S1506
Nx≧3 ?
NO
YES
S1508
Ny≧3 ?
NO
YES
S1509
DETERMINE THAT THE AREA FORMS A TABLE
DETERMINE THAT THE AREA FORMS A MODIFIED SEPARATOR
S1507
END

FIG. 27

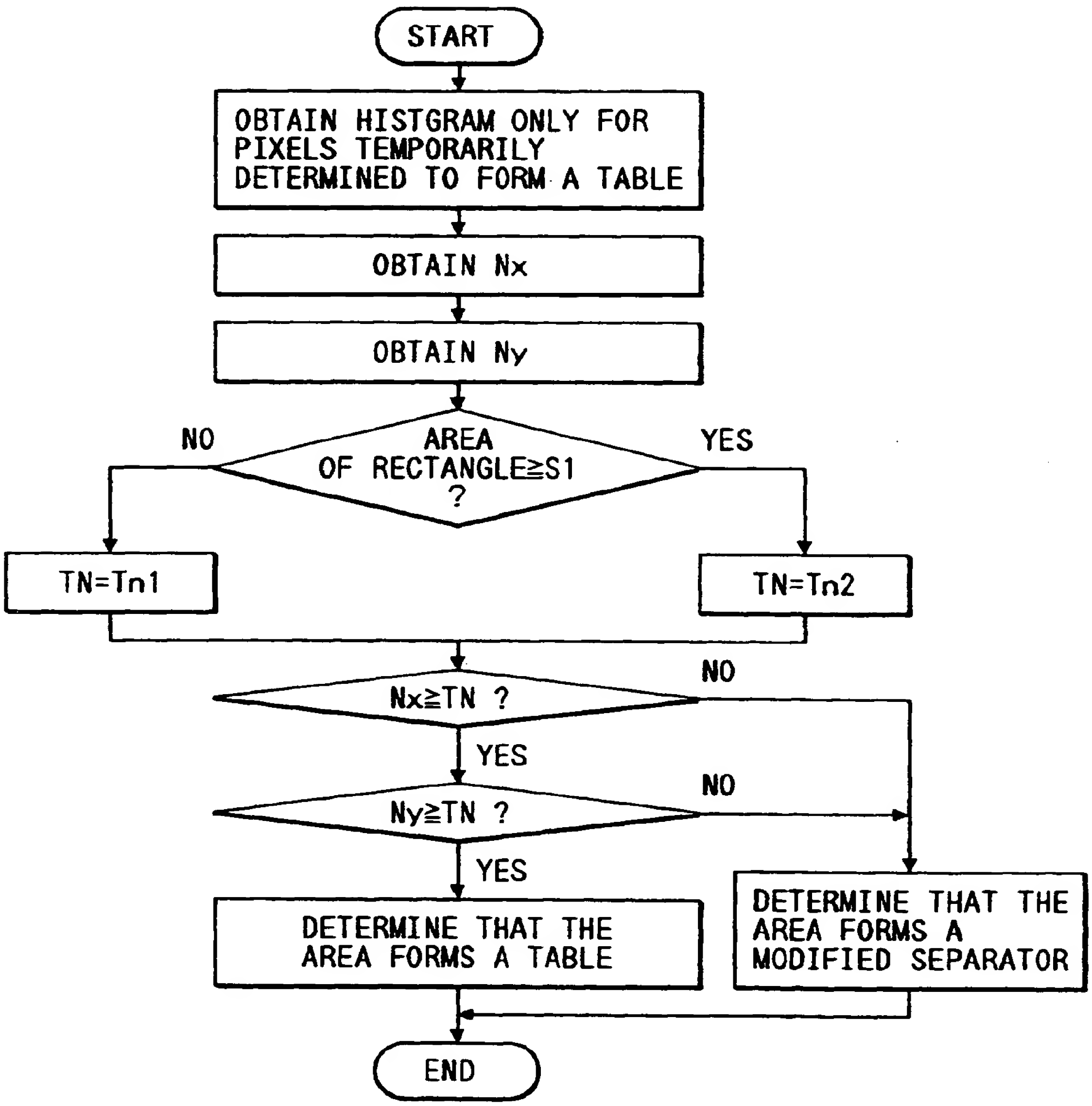

START
OBTAIN HISTGRAM ONLY FOR PIXELS TEMPORARILY DETERMINED TO FORM A TABLE
OBTAIN Nx
OBTAIN Ny
AREA OF RECTANGLE≧S1 ?
NO
YES
TN=Tn1
TN=Tn2
Nx≧TN ?
NO
YES
Ny≧TN ?
NO
YES
DETERMINE THAT THE AREA FORMS A TABLE
DETERMINE THAT THE AREA FORMS A MODIFIED SEPARATOR
END

FIG. 28

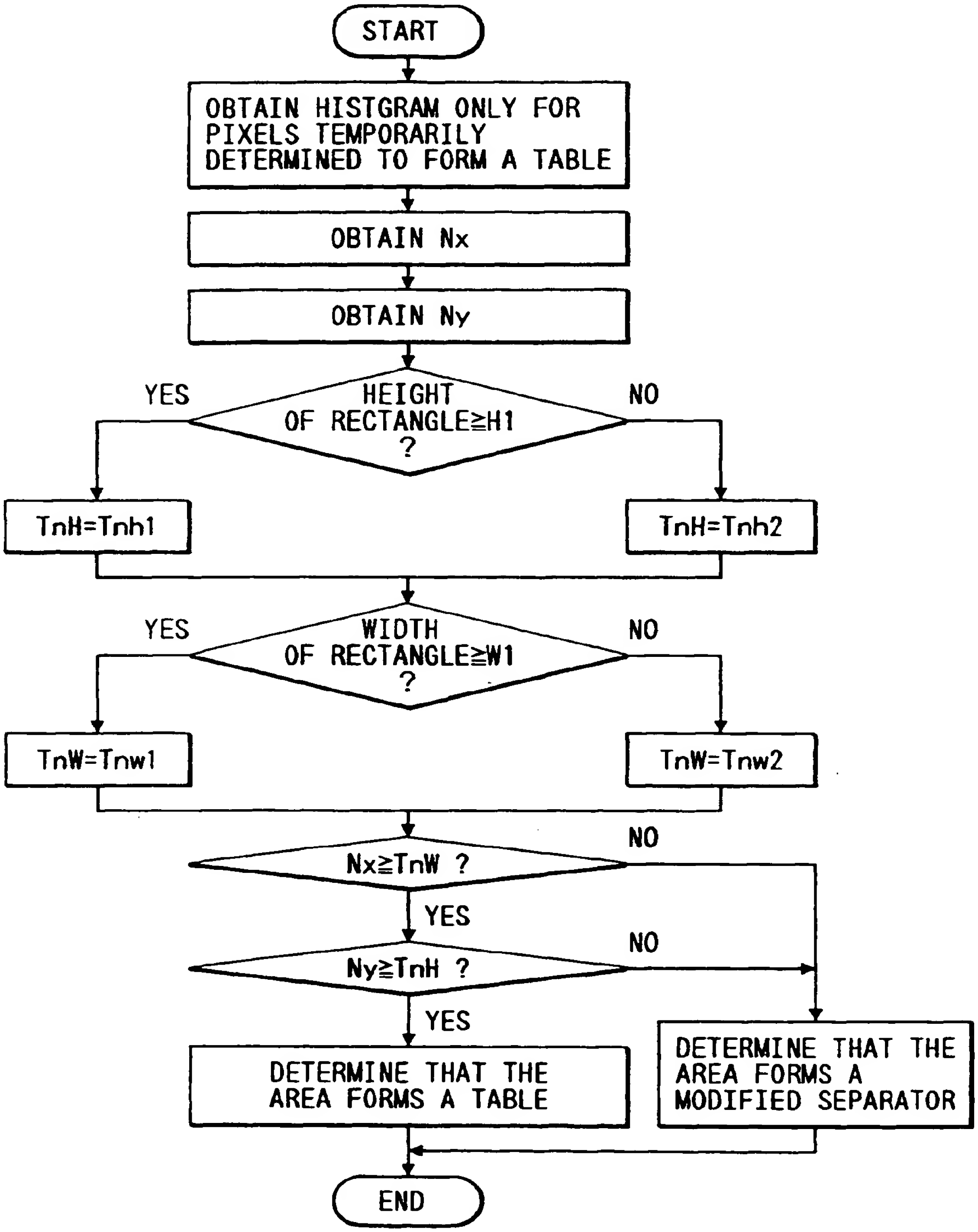

START
OBTAIN HISTGRAM ONLY FOR PIXELS TEMPORARILY DETERMINED TO FORM A TABLE
OBTAIN Nx
OBTAIN Ny
HEIGHT OF RECTANGLE≧H1 ?
YES
NO
TnH=Tnh1
TnH=Tnh2
WIDTH OF RECTANGLE≧W1 ?
YES
NO
TnW=Tnw1
TnW=Tnw2
Nx≧TnW ?
NO
YES
Ny≧TnH ?
NO
YES
DETERMINE THAT THE AREA FORMS A TABLE
DETERMINE THAT THE AREA FORMS A MODIFIED SEPARATOR
END

FIG. 29

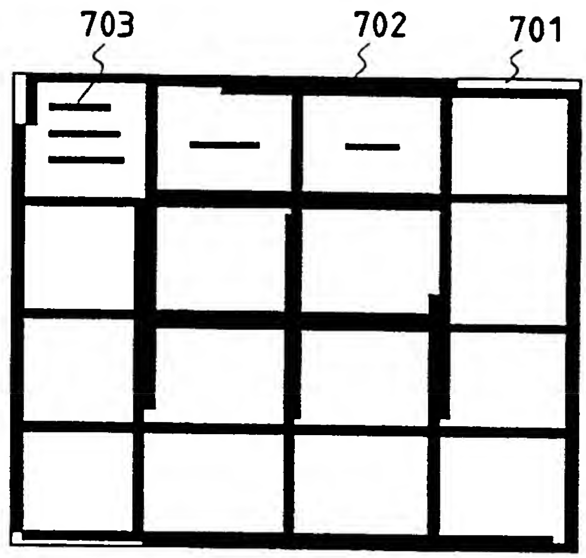


FIG. 30

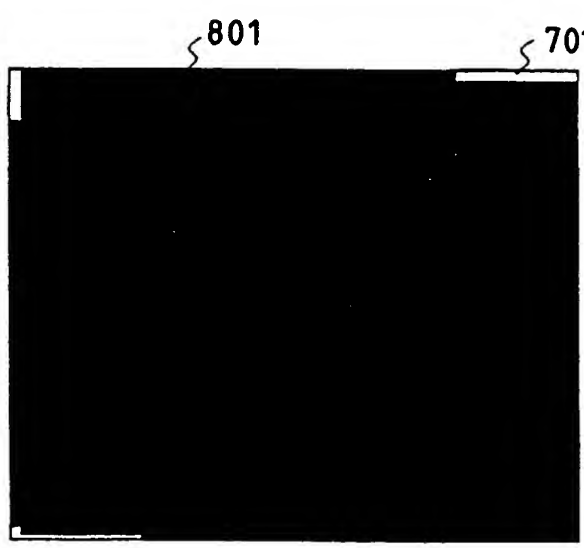


FIG. 31

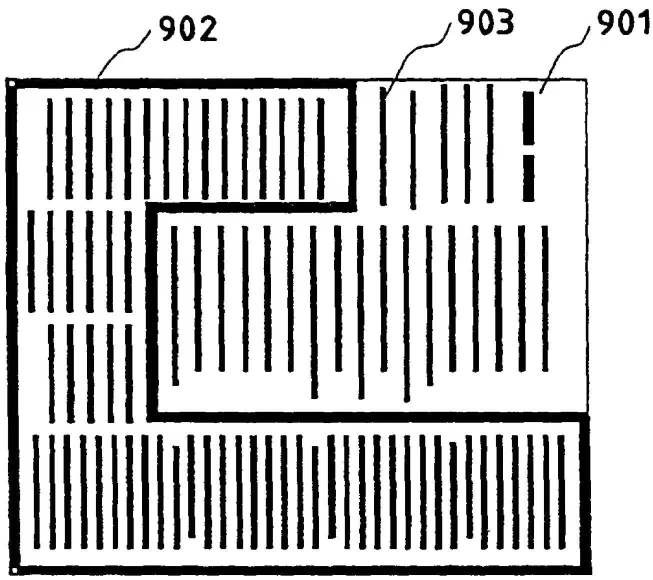


FIG. 32

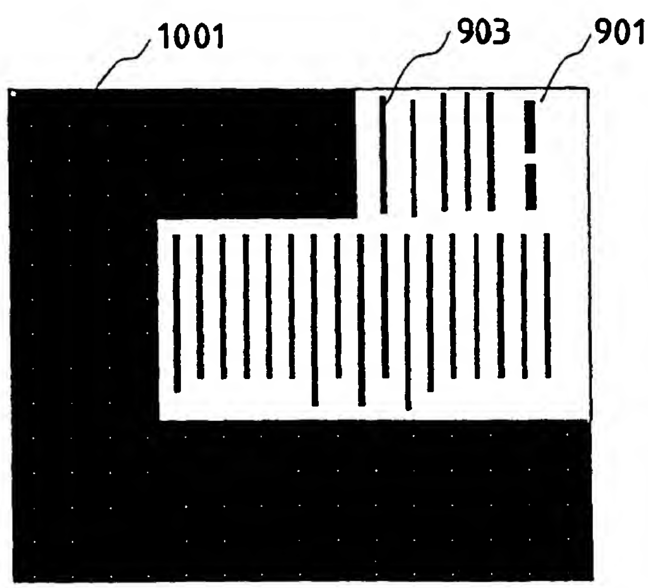


FIG. 33

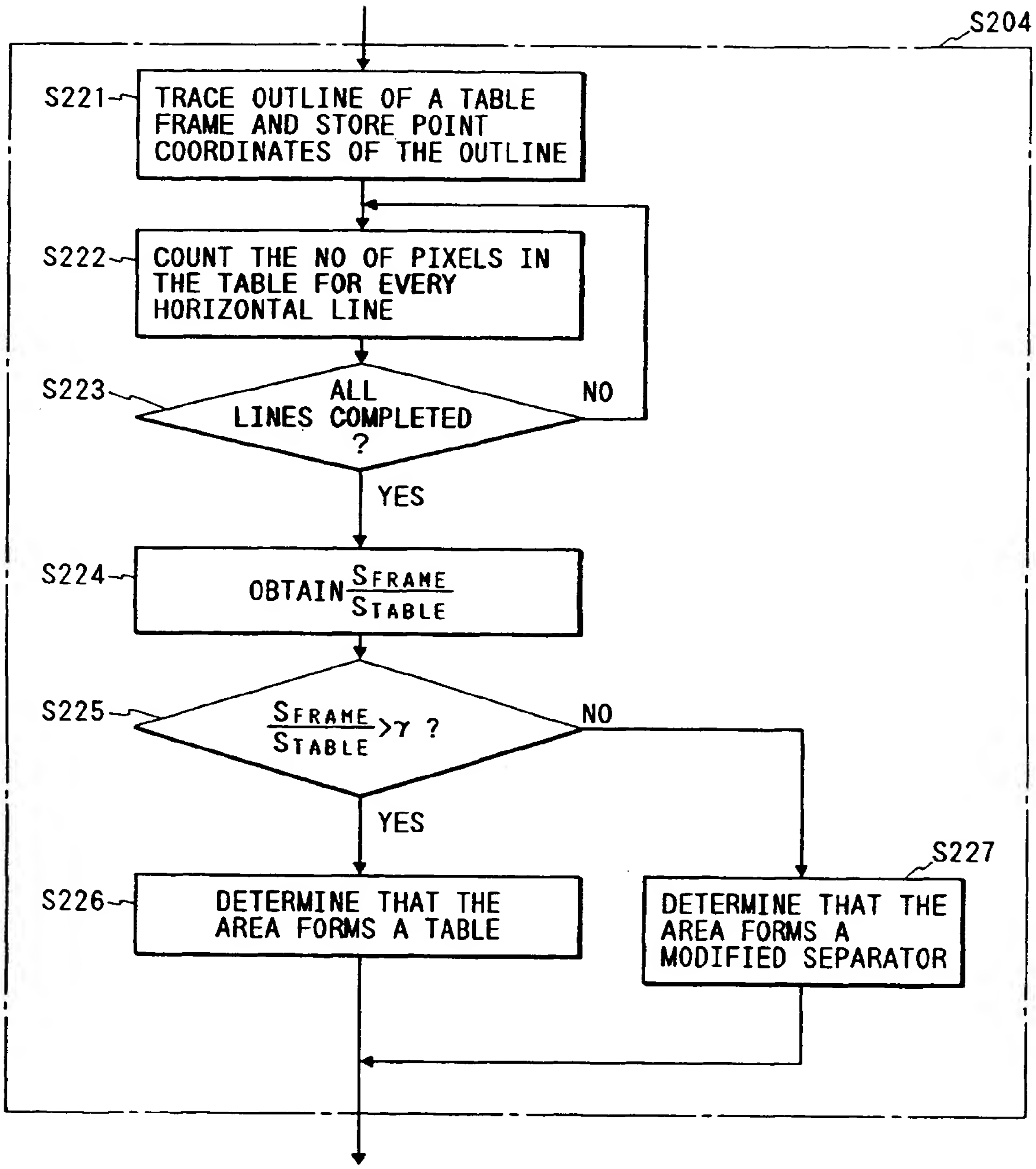

S204
S221
TRACE OUTLINE OF A TABLE FRAME AND STORE POINT COORDINATES OF THE OUTLINE
S222
COUNT THE NO OF PIXELS IN THE TABLE FOR EVERY HORIZONTAL LINE
S223
ALL LINES COMPLETED ?
NO
YES
S224
OBTAIN SFRAME/STABLE
S225
SFRAME/STABLE >γ ?
NO
YES
S226
DETERMINE THAT THE AREA FORMS A TABLE
S227
DETERMINE THAT THE AREA FORMS A MODIFIED SEPARATOR

FIG. 34

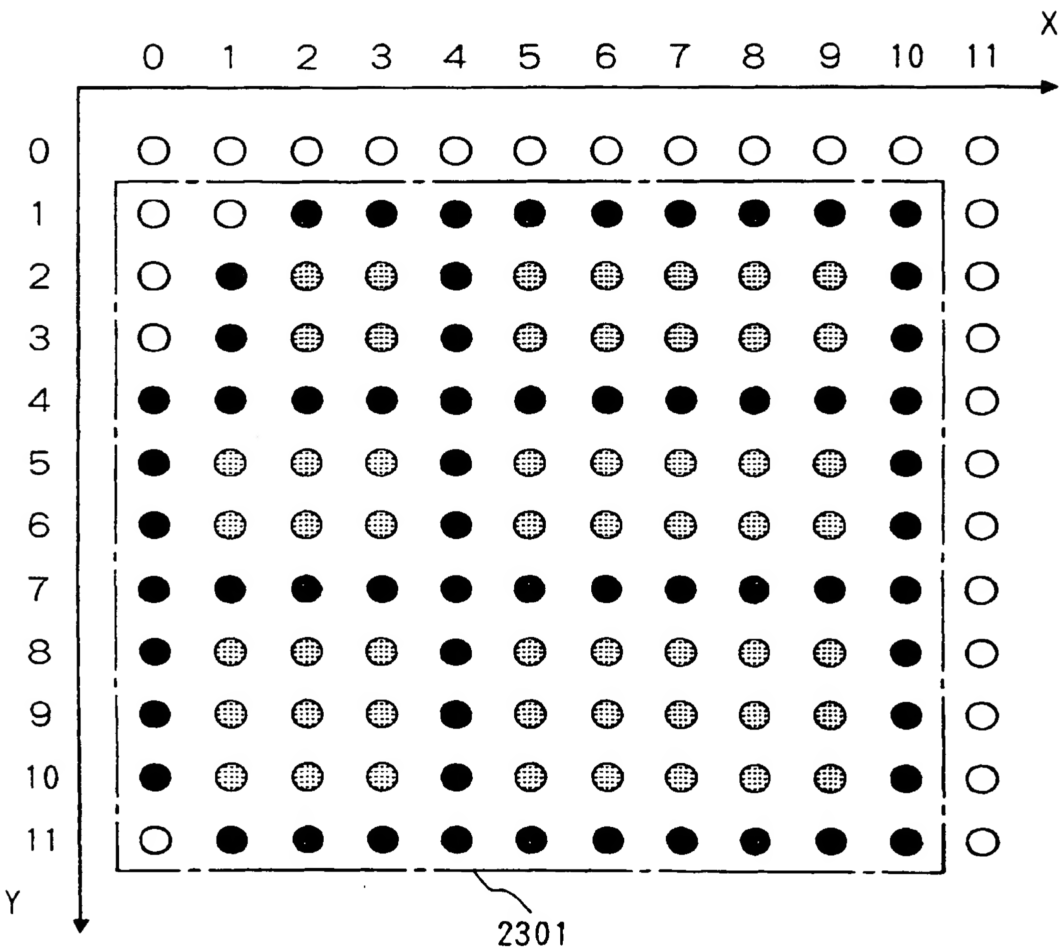


FIG. 35

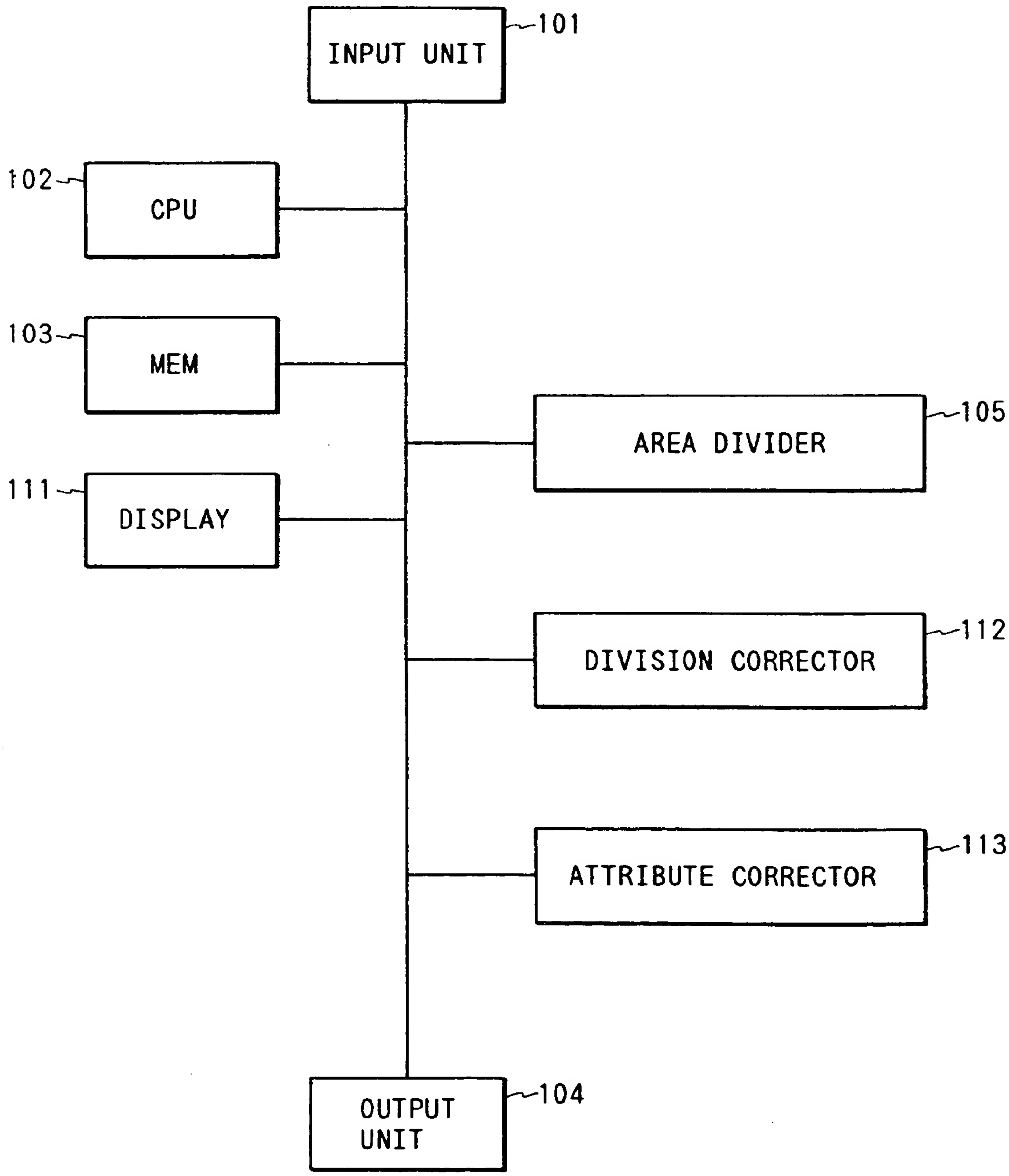

INPUT UNIT
101
102
CPU
103
MEM
111
DISPLAY
AREA DIVIDER
105
DIVISION CORRECTOR
112
ATTRIBUTE CORRECTOR
113
OUTPUT UNIT
104

FIG. 36

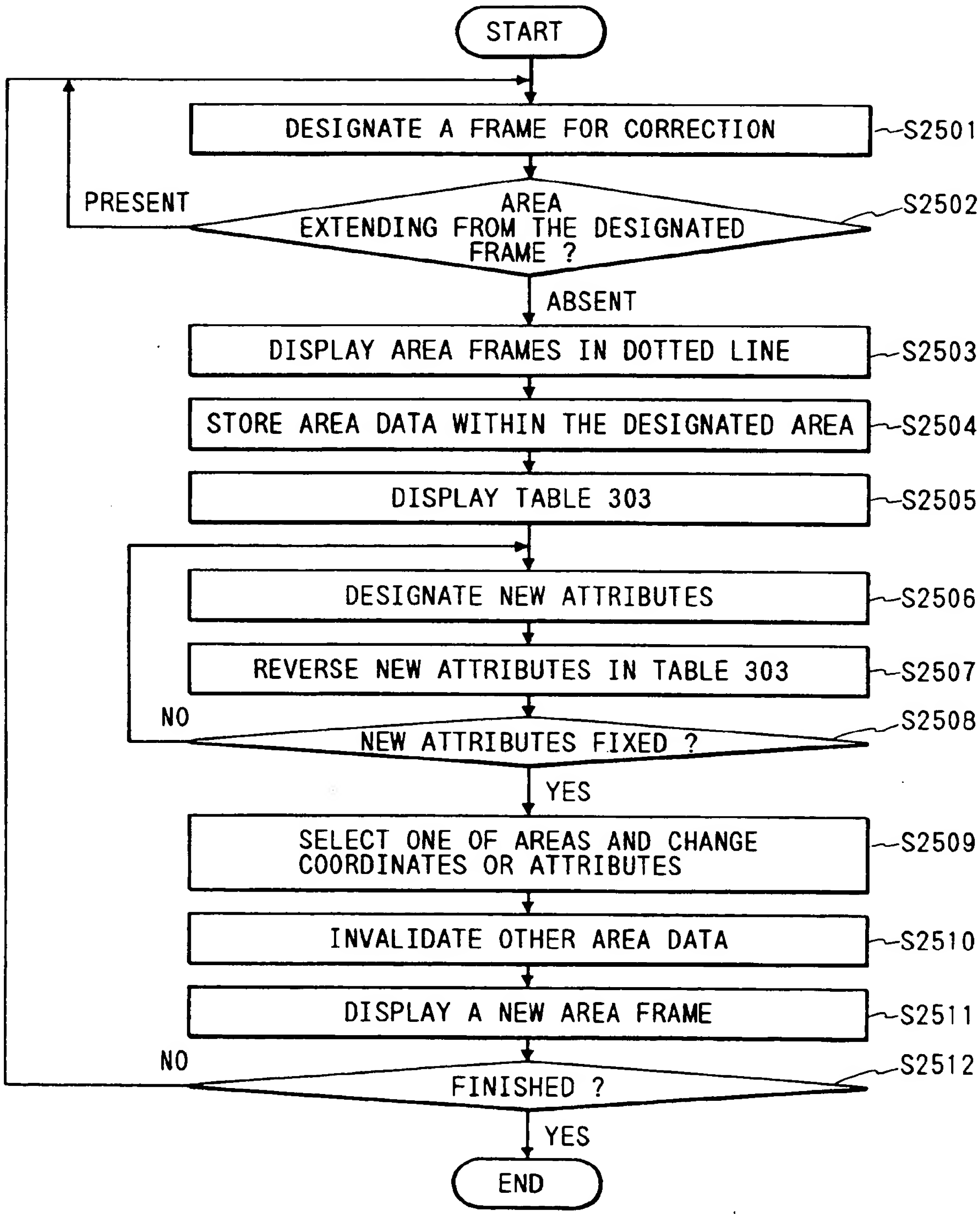

START
DESIGNATE A FRAME FOR CORRECTION
S2501
AREA EXTENDING FROM THE DESIGNATED FRAME ?
S2502
PRESENT
ABSENT
DISPLAY AREA FRAMES IN DOTTED LINE
S2503
STORE AREA DATA WITHIN THE DESIGNATED AREA
S2504
DISPLAY TABLE 303
S2505
DESIGNATE NEW ATTRIBUTES
S2506
REVERSE NEW ATTRIBUTES IN TABLE 303
S2507
NO
NEW ATTRIBUTES FIXED ?
S2508
YES
SELECT ONE OF AREAS AND CHANGE COORDINATES OR ATTRIBUTES
S2509
INVALIDATE OTHER AREA DATA
S2510
DISPLAY A NEW AREA FRAME
S2511
NO
FINISHED ?
S2512
YES
END

FIG. 37

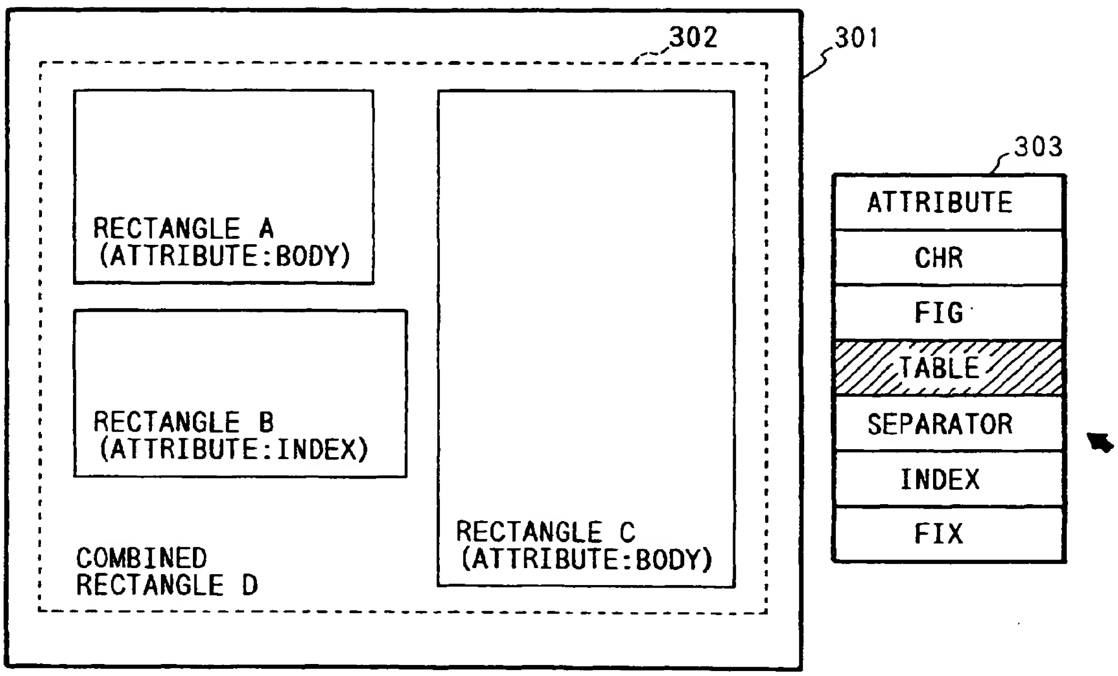


FIG. 38

AREA DATA
INITIAL POINT COORDINATE
TERMINAL POINT COORDINATE
ATTRIBUTES

FIG. 39

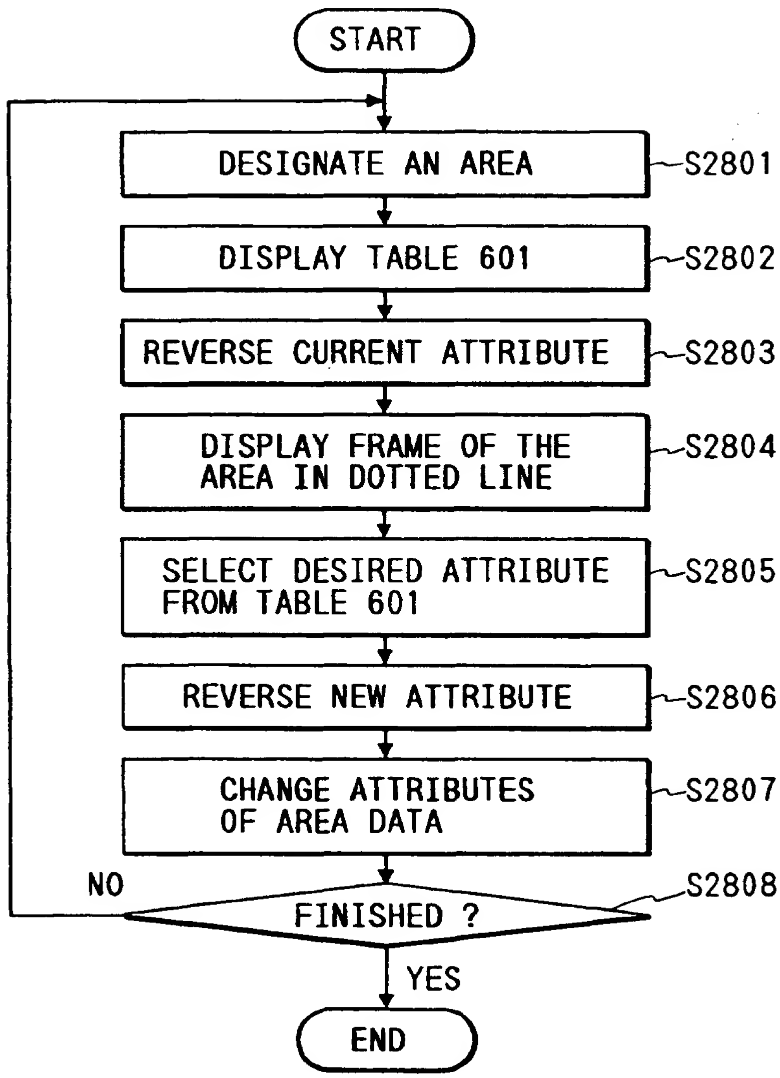

START
DESIGNATE AN AREA
S2801
DISPLAY TABLE 601
S2802
REVERSE CURRENT ATTRIBUTE
S2803
DISPLAY FRAME OF THE AREA IN DOTTED LINE
S2804
SELECT DESIRED ATTRIBUTE FROM TABLE 601
S2805
REVERSE NEW ATTRIBUTE
S2806
CHANGE ATTRIBUTES OF AREA DATA
S2807
NO
FINISHED ?
S2808
YES
END

FIG. 40

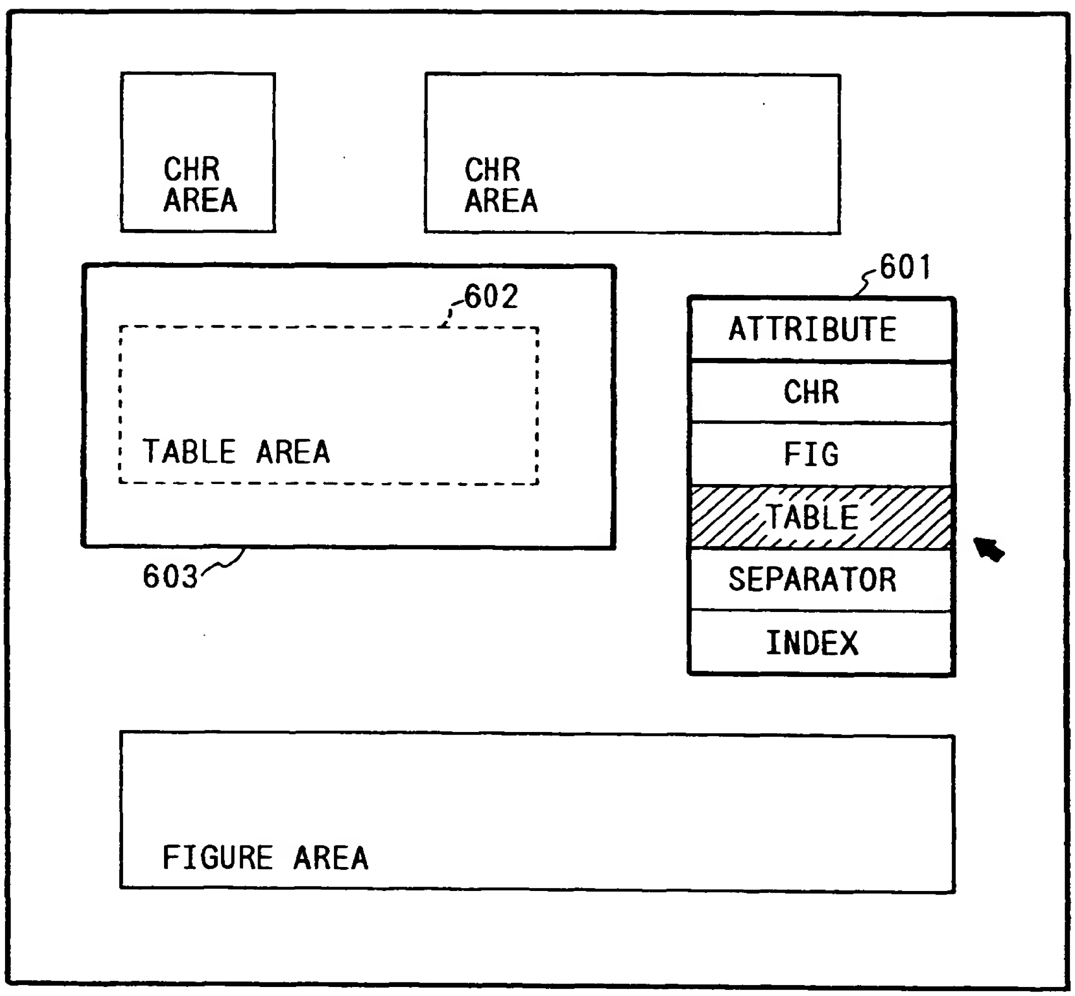

CHR
AREA
CHR
AREA
602
TABLE AREA
603
601
ATTRIBUTE
CHR
FIG
TABLE
SEPARATOR
INDEX
FIGURE AREA

FIG. 41

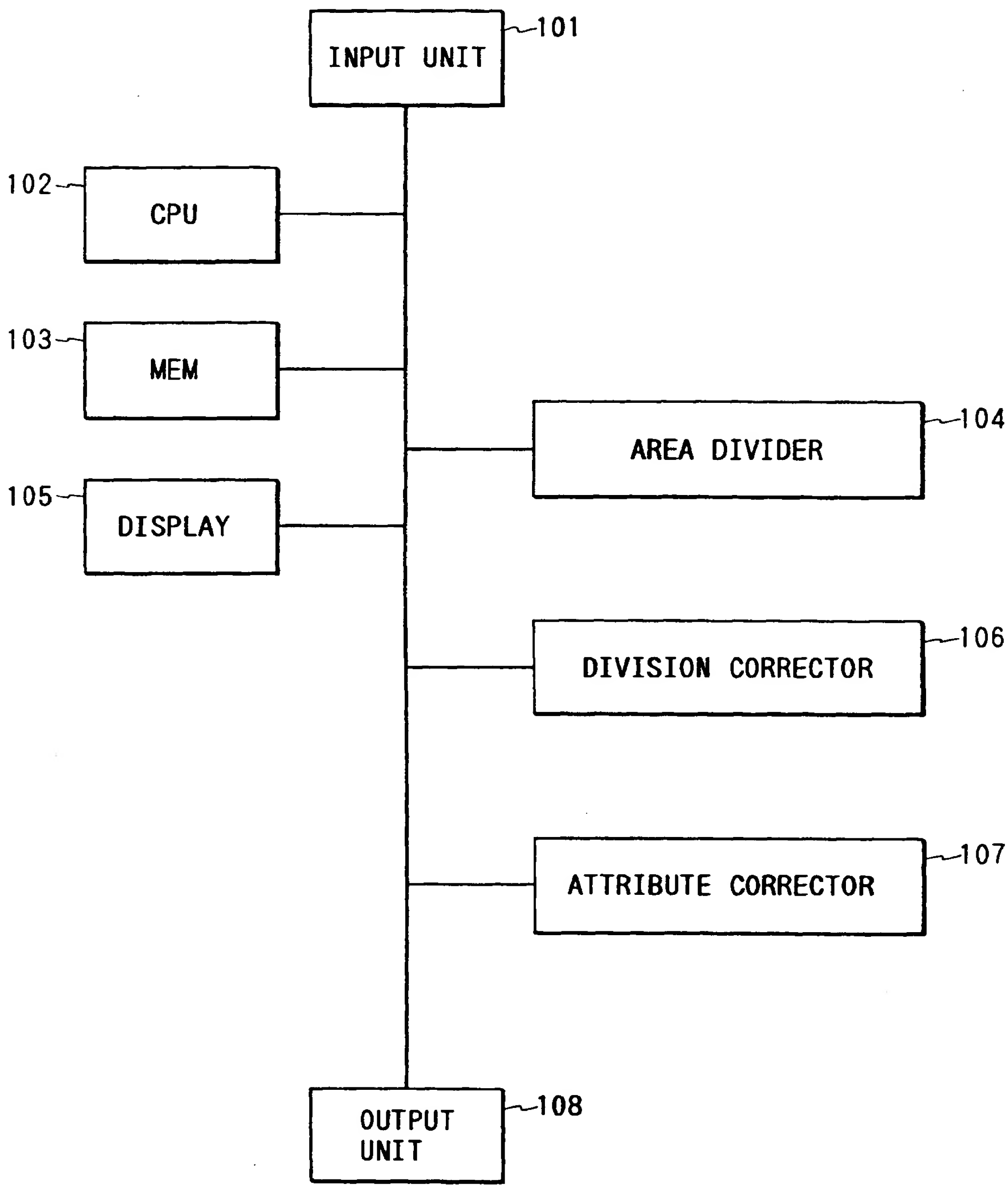

INPUT UNIT
101
102
CPU
103
MEM
AREA DIVIDER
104
105
DISPLAY
DIVISION CORRECTOR
106
ATTRIBUTE CORRECTOR
107
OUTPUT UNIT
108

FIG. 42

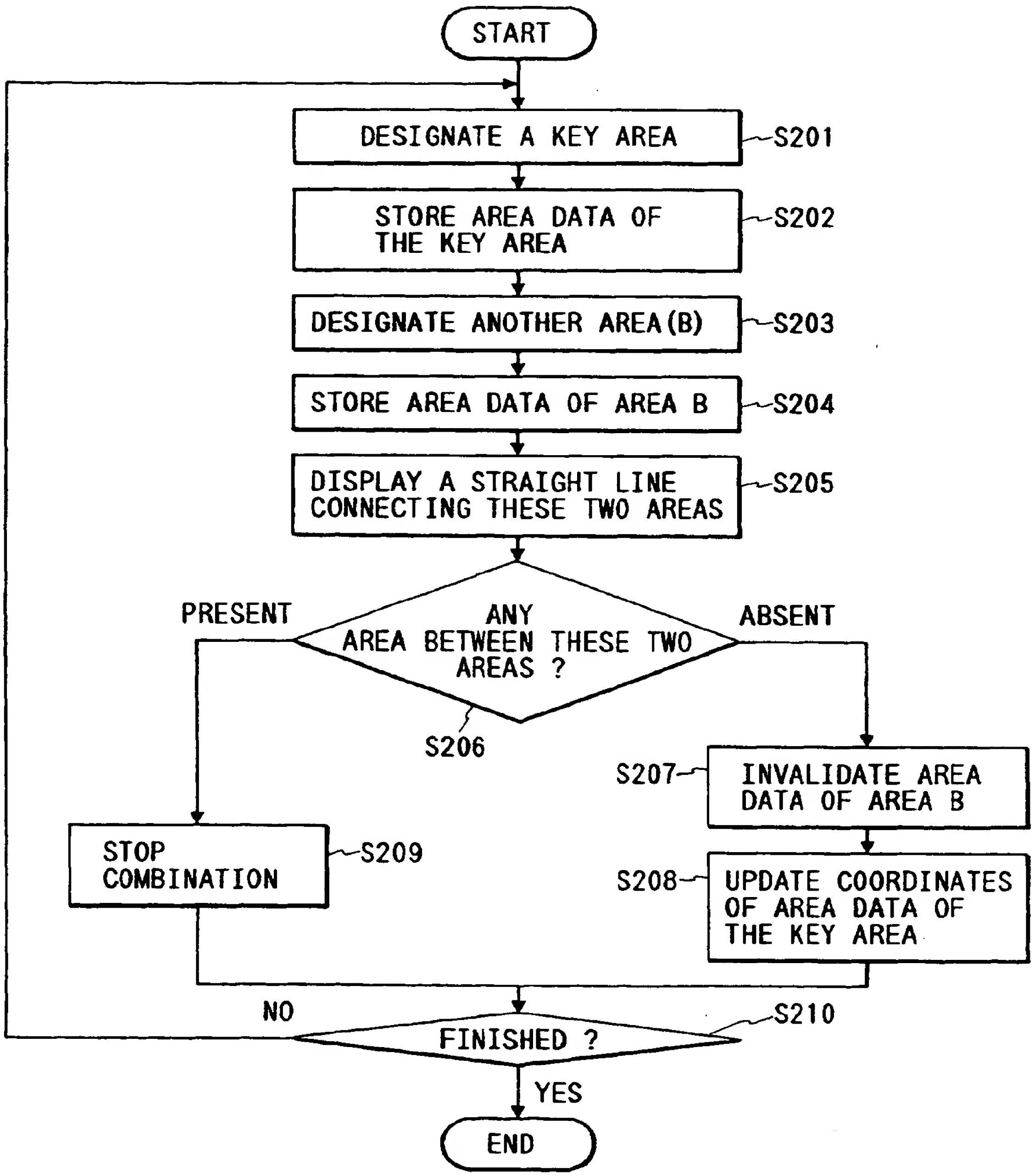

START
DESIGNATE A KEY AREA
S201
STORE AREA DATA OF THE KEY AREA
S202
DESIGNATE ANOTHER AREA (B)
S203
STORE AREA DATA OF AREA B
S204
DISPLAY A STRAIGHT LINE CONNECTING THESE TWO AREAS
S205
ANY AREA BETWEEN THESE TWO AREAS ?
S206
PRESENT
ABSENT
S207
INVALIDATE AREA DATA OF AREA B
STOP COMBINATION
S209
S208
UPDATE COORDINATES OF AREA DATA OF THE KEY AREA
NO
FINISHED ?
S210
YES
END

FIG. 43

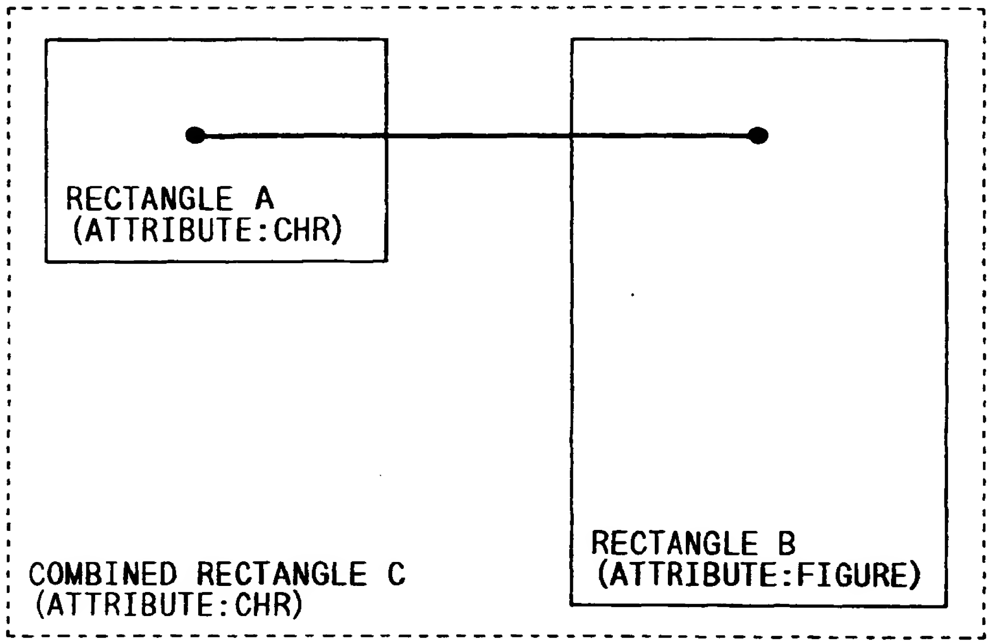


FIG. 44

AREA DATA
INITIAL POINT COORDINATE
TERMINAL POINT COORDINATE
ATTRIBUTES

FIG. 45

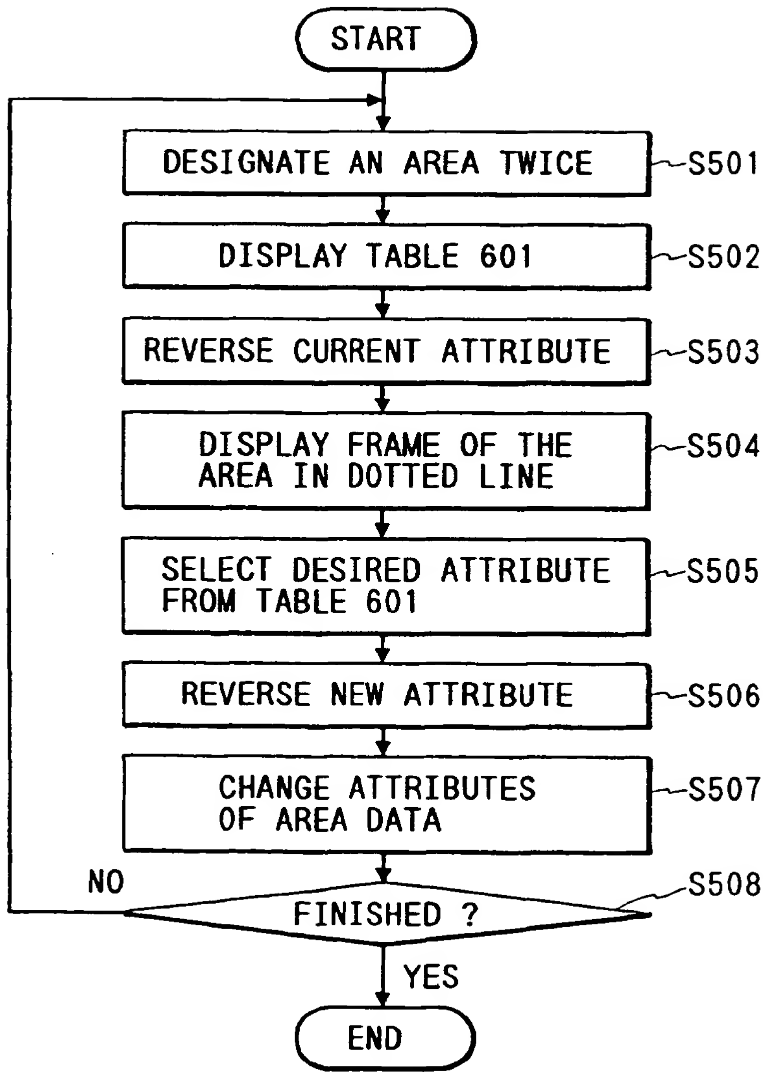
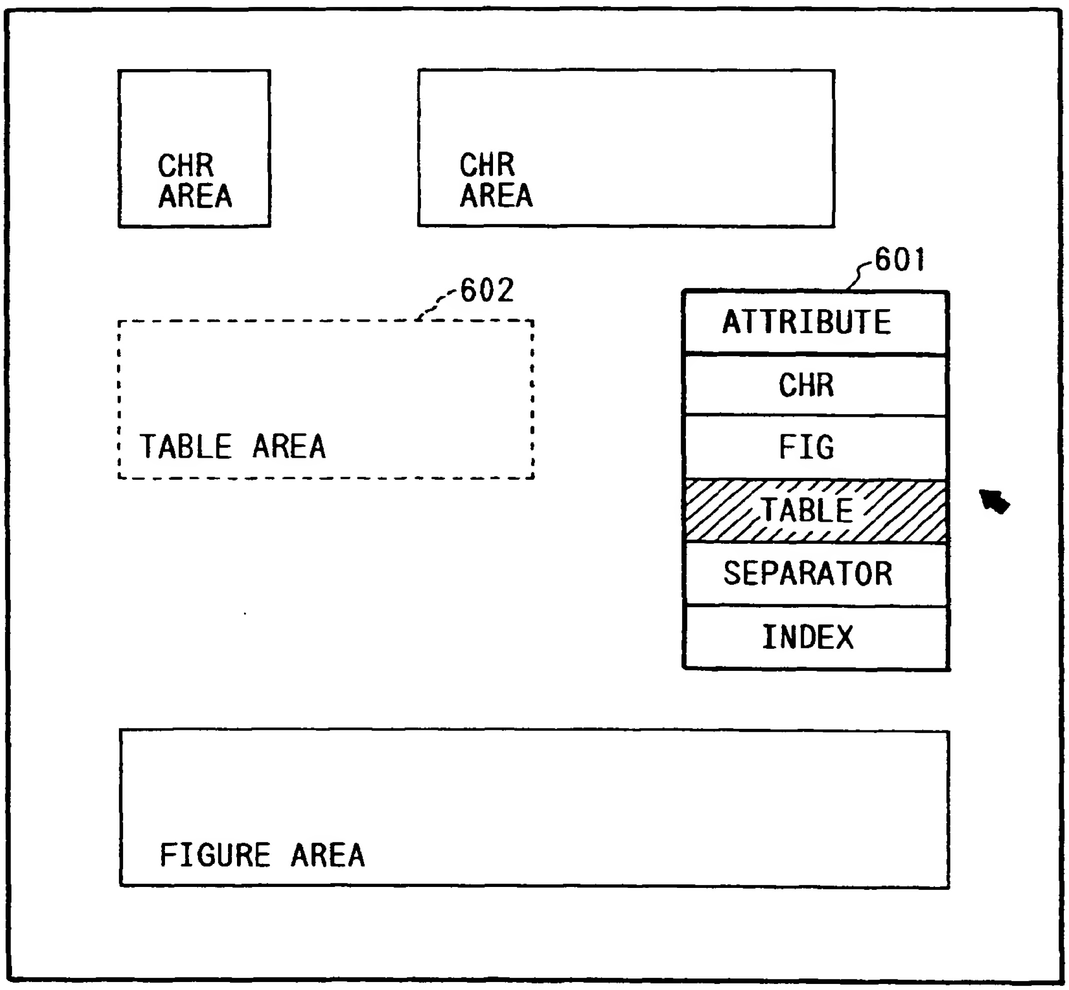

START
DESIGNATE AN AREA TWICE
S501
DISPLAY TABLE 601
S502
REVERSE CURRENT ATTRIBUTE
S503
DISPLAY FRAME OF THE AREA IN DOTTED LINE
S504
SELECT DESIRED ATTRIBUTE FROM TABLE 601
S505
REVERSE NEW ATTRIBUTE
S506
CHANGE ATTRIBUTES OF AREA DATA
S507
NO
FINISHED ?
S508
YES
END

FIG. 46


CHR
AREA
CHR
AREA
601
602
ATTRIBUTE
CHR
FIG
TABLE
SEPARATOR
INDEX
TABLE AREA
FIGURE AREA

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 93 30 7181
PAGE1

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
P,A	US-A-5 202 933 (BLOOMBERG) * column 3, line 11 - column 7, line 5; figure 1 * ---	1	G06K9/20 H04N1/40
Y	EP-A-0 496 531 (INTERNATIONAL BUSINESS MACHINES CORPORATION) * page 5, line 13 - page 8, line 2; figure 3 * ---	3,4,7,8, 11,12	
Y	FUJITSU-SCIENTIFIC AND TECHNICAL JOURNAL vol. 26, no. 3, September 1990, KAWASAKI JP pages 224 - 233 SATO ET AL. 'F6365 Japanese Document Reader' * page 224, column 1, line 27 - page 227, column 1, line 22; figures 1-4 * ---	3,4,7,8	
Y	PATENT ABSTRACTS OF JAPAN vol. 15, no. 494 (E-1145)13 December 1991 & JP-A-32 14 967 (MINOLTA CAMERA CO LTD) 20 September 1991 * abstract * ---	11,12	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
X	SIGNAL PROCESSING VI, THEORIES AND APPLICATIONS, PROCEEDINGS OF EUSIPCO-92, SIXTH EUROPEAN SIGNAL PROCESSING CONFERENCE. 24 August 1992, BRUSSELS pages 615 - 618 CHANG ET AL. 'Rule-Based System for Chinese Newspaper Segmentation' * page 616, column 1, line 32 - column 2, line 34 * --- -/--	13,15	H04N G06K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	22 DECEMBER 1993	MATERNE A.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 93 30 7181
PAGE2

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	NEC RESEARCH AND DEVELOPMENT vol. 32, no. 3, July 1991, TOKYO JP pages 430 - 437 MIZUNO ET AL. 'Document Recognition System with Layout Structure Generator'	15	
A	* page 433, column 2 - page 435, column 1, line 12; figures 1-7 *	1-14	
D,A	PATENT ABSTRACTS OF JAPAN vol. 13, no. 191 (P-867)9 May 1989 & JP-A-10 15 889 (NEC CORP) 19 January 1989 * abstract *	1-15	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

The present search report has been drawn up for all claims

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& : member of the same patent family, corresponding document

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